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NOVEMBER 1946

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This Month's Cover

Coremaking and molding practice has advanced rapidly in recent years as a result of increasingly rigid quality and dimensional tolerance demands on the foundry.

Photo courtesy Muskegon Piston Ring Co., Sparta, Mich.

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★ NOVEMBER WHO'S WHO ★

J. L. Yates

In this issue James L. Yates presents information on *Mechanical Shakeout* . . . Born in Fall River, Mass. . . . Obtained his technical education at Millard Filmore College and Massachusetts Institute of Technology, Cambridge . . . Began his industrial career with Worthington Pump & Machinery Corp., Buffalo, N. Y., in 1919 . . . Starting as junior assistant mechanical engineer he held the following positions: test engineer, experimental engineer, field engineer, manager of service and erection division, chief of inspection and test, and construction engineer in charge of plant and foundry expansion . . . Joined National Engineering Co., Chicago, in 1946 as consulting engineer . . . Taught modern foundry practice, University of Buffalo, Buffalo, N. Y. . . . Has written frequently for the trade press and meetings of technical societies on such subjects as power plant equipment, foundry layout, foundry hygiene and foundry shakeout . . . Member of A.F.A. and ASME.

Phil Carroll, Jr.

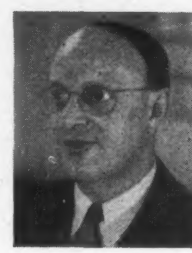
Appearing in this issue: *What Management Should Know About Timestudy* . . . A graduate of University of Michigan, Ann Arbor, Mich., in electrical engineering . . . During World War I served in the Army Signal Corps . . . Following the war he became associated with Westinghouse Electric Corp. as student engineer . . . Was transferred to the timestudy department and worked in three Westinghouse plants . . . In 1923 was affiliated with a Cleveland concern doing timestudy planning and costing . . . One year later helped to found Dyer Engineers and later was made vice-president in charge of operations . . . While serving in this capacity he obtained personal experience in the practical application of wage incentive and cost control . . . In 1940 established his own practice as a management consultant . . . Also holds the position of vice-president in charge of regional development, Society for the Advancement of Management . . . He is a professional engineer in New York state . . . Is author of *Timestudy Fundamentals for Foremen; Timestudy for Cost Control* and is a contributor to the *Foreman's Handbook* . . . Has spoken before a number of associations and technical groups on timestudy and wage incentive.

R. H. Hardy

Author (with associate J. T. Robertson) of Naval Research paper herein on *Bronze Castings, Conditions of Flow* . . . Mr. Hardy was born in Rockland, Maine . . . Received his technical education at Carnegie Institute of Technology, Pittsburgh, Pa. . . . Became metallurgist on staff of Naval Reserve Laboratory, Washington, D. C., 1943-45 . . . During World War II served as a chief petty officer, U. S. Naval Reserve, assigned to the Naval Reseach Laborartory . . . At present holds the position of metallurgist, Ohio Brass Co., Mansfield, Ohio . . . A member of A.F.A. and ASM.

J. G. Kura

The heat treatment of cast steel is covered in a paper written by J. G. Kura and P. C. Rosenthal . . . Appearing in this issue the results of this study is published as *Cast Steel, Homogenization Heat Treatments* . . . Mr. Kura was born in Pittsburgh . . . Received his diploma in 1938, graduating from Carnegie Institute of Technology, Pittsburgh, with a Bachelor of Science degree in metallurgical engineering . . . Upon graduating became connected with Carnegie-Illinois Steel Corp., Duquesne works, Duquesne, Pa. . . . In 1941 joined the staff at Battelle Memorial Institute, Columbus, Ohio, as research engineer.



R. G. Ferrell

Mr. Ferrell, whose article on *Cores for Automotive Malleable Castings* appears in this magazine, is general works manager, Auto Specialties Mfg. Co., St. Joseph, Mich. . . . Served his apprenticeship in patternmaking with Wm. E. Pratt Foundry, Joliet, Ill. . . . Upon completion of the course he became affiliated with the Joliet plant, Auto Specialties Mfg. Co. as a patternmaker . . . Was moved to the St. Joseph plant in 1917 . . . From 1917-46 the author has held every job in the foundry and was just recently promoted from general superintendent of foundries to general works manager and placed in charge of operations of all divisions of the firm.

P. C. Rosenthal

From the Badger state comes P. C. Rosenthal . . . Born in the city of West Allis . . . A graduate of the University of Wisconsin, Madison, with a Bachelor of Science degree in metallurgical engineering . . . A member of the class of '35 . . . Associated with Battelle Memorial Institute, Columbus, Ohio, for 2½ years as research engineer working on process metallurgy problems . . . Returned to the University of Wisconsin as an instructor in metallurgy . . . Received a Master of Science degree in 1939 and continued with graduate work while teaching . . . In 1941 accepted a position as assistant supervisor in process metallurgy at Battelle and remained there until the end of 1945 . . . Assumed

the position of associate professor of metallurgy, University of Wisconsin, in 1946 . . . Co-author of papers dealing with malleable iron, cast steel and related subjects . . . Contributor, with J. G. Kura, in this issue, of *Cast Steel, Homogenization Heat Treatments.*

R. H. Zoller

Rammed Refractories In Electric Furnaces is presented in this issue . . . Author, R. H. Zoller, began his association with the castings industry in 1936 with the Wehr Steel Co., Milwaukee . . . During his affiliation with Wehr, the author enrolled at the University of Wisconsin's extension division in Milwaukee and successfully completed a number of courses in metallurgy . . . Assumed the position of metallurgist with Valley Steel Co., Bay City, Mich., in 1940 . . . Two years later, 1942, was named superintendent of melting, Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich. . . . At present is general manager, Zoller Casting Co., Bettsville, Ohio . . . Member of A.F.A.

J. T. Robertson

Aberdeen, Scotland, was the birthplace of John T. Robertson, co-author with R. G. Hardy of *Bronze Castings, Conditions of Flow* . . . From Northeastern University, Boston, he was graduated, class of '43, with a Bachelor of Science degree in chemical engineering . . . A member of the engineering staff, Naval Research Laboratory, Washington, D. C., he was a research metallurgist . . . Early in 1946 joined Rustproofing & Metal Finishing Corp., Cambridge, Mass., as sales engineer . . . Prepared a paper for A.F.A. in 1944 and has contributed other papers to the trade press on non-ferrous foundry practice . . . Holds membership in AIME, ASM, Institute of Metals (British) and A.F.A.

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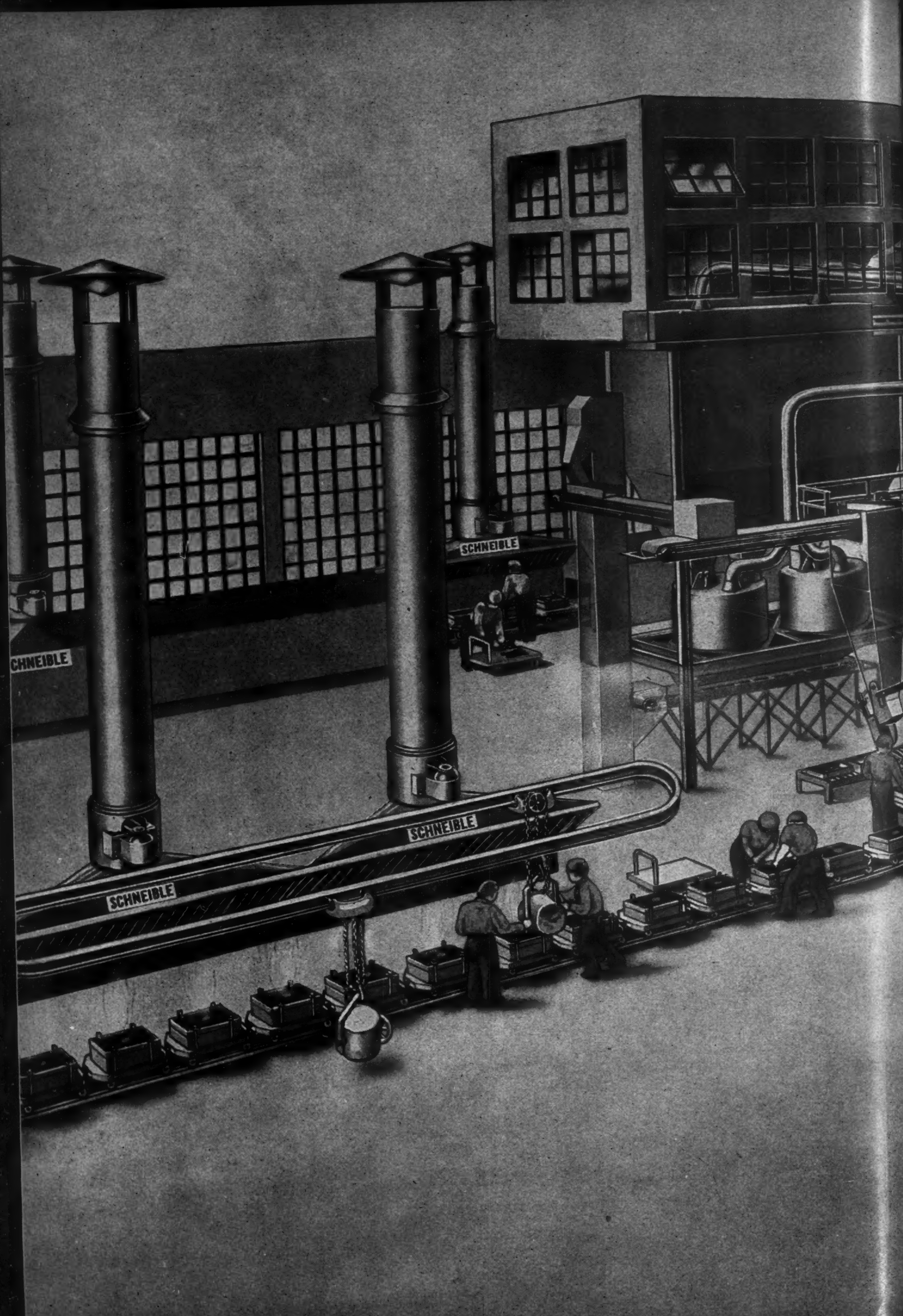

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TECHNICAL DEVELOPMENT OF THE FOUNDRY INDUSTRY

INDUSTRIAL MANAGEMENT is constantly faced with the necessity of improved methods. Efficiency of operation and suitable working conditions, coupled with agreeable company-employee relations, spell success in any enterprise. Administrative heads of foundries, like those of all other industries, have become increasingly conscious of the importance of these factors and the many others necessary to successful operation.

One all-important problem is perpetuation of a profitable enterprise in the face of ever-increasing competition by manufacturers of the same or a similar product. The answer here is, unquestionably, unceasing technological development and the thorough training of employees to implement each new development. No individual, no group of individuals comprising a single company, however, is capable of full technical development without building in some measure upon the experience of others—in other words, without the assistance of others. Foundrymen in growing numbers find that the basic technical help they need is most easily acquired in the interchange of information made possible by technical societies.

Technical societies afford each member an opportunity to acquire information from the most capable professional minds; one of their first purposes is the interchange and dissemination of technical information. Their chapter meetings promote informal discussion and their annual meetings represent an accumulation of authoritative and carefully recorded results of the investigations of others. Society publications reflect a cooperative effort of outstanding authorities, and represent works that would otherwise be unavailable.

More than one foundry executive measures his success in the castings field in terms of what he learned through his associations as a member of A.F.A.

Technological progress is constantly evident. The most useful mechanical devices, such as the modern airplane and other vehicles of transportation, would be impossible were it not for the developments of the metallurgical field as a whole, and, specifically, those of the foundry. The limitations imposed on designers are only those imposed by the ability of manufacturers to produce the parts required. Success of foundrymen and the continuation of a foundry as a successful enterprise depend upon ability to meet such demands.

In turn, the future of A.F.A. and its value to the foundry industry can be measured definitely in terms of the willingness of its members to contribute their experiences and their knowledge, to the end that the industry as a whole may advance equally. That will insure not only its continuation but also its growth.

S. C. MASSARI, *Director,*
A.F.A. TECHNICAL DEVELOPMENT PROGRAM.

S. C. MASSARI, *author of the above editorial, is Director, A.F.A. Technical Development Program. A well known figure in the field of ferrous metallurgy, he was chief metallurgist in charge of research, Association of Manufacturers of Chilled Car Wheels, prior to his entering military service. Author and speaker, Mr. Massari has presented technical papers before A.F.A. conventions and chapter meetings.*

CAST STEEL

HOMOGENIZATION HEAT TREATMENTS

John G. Kura
and
Philip C. Rosenthal
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Columbus, Ohio

It is common practice to "homogenize" the heterogeneous, coarse-grained structure developed during the solidification of a steel casting. It is generally assumed that the treatment refines the grain, diffuses segregated areas resulting from the dendritic mode of freezing, and improves the mechanical properties, particularly ductility and toughness.

Homogenizing heat treatment is generally carried out at temperatures considerably higher than those used for normal heat-treating practice, but there is no consistency among producers in regard to the temperature or the holding time at temperature. Thus, it is not unusual to find one steel foundry homogenizing at 1700° F. for 4 hr. and another at 2000° F. for 10 hr. for castings of the same section size.

While composition of the steel and heat-treating facilities govern to some extent the choice of homogenizing heat treatment, there can be no doubt that variations in time and temperature as great as those mentioned are much beyond the normal range imposed by these factors. The implication to be derived from this decided lack of uniformity in homogenizing heat-treating practice is that there is no unanimity of opinion in the cast-steel industry regarding the value of homogenizing; yet the advantages to be gained if such opinion could be brought to closer agreement are perfectly obvious.

If it is true that a drastic heat treatment of many hours at high temperatures is necessary, then certainly those who now employ the lower temperatures and shorter holding times are not realizing the maximum properties from their steels. On the other hand, if there is no particular advantage in going to higher temperatures and longer times, or if the advantage is so slight that a minor adjustment in composition would compensate for it, then the drastic heat treatments could well be curtailed to save time and heat-treating capacity.

Survey Made

To obtain a better understanding of the worth of homogenizing heat treatments and to accumulate a set of data that would be useful to the cast-steel producers in governing their heat-treating practice, an extensive survey of the homogenizing heat treatment was undertaken at Battelle Memorial Institute on 36x36x2-in. cast-steel plates. These plates, which were submitted by five producers, were sectioned into coupons and each coupon given a different homogenizing heat treatment.

Range of temperature and holding time covered the extremes currently existing in actual practice, and in one instance exceeded the upper commercial homogenizing temperature. After quenching and tempering, each coupon was cut into tensile and notched-bar specimens and into specimens suitable for macro- and micro-examination.

Hardenability tests were made on standard end-quench specimens machined from the coupons after they were homogenized. Correlative studies were concerned with temper-brittleness susceptibility and low-temperature toughness. The final result was a comprehensive survey of the hardenability and mechanical properties of the five commercial plates after a variety of homogenizing heat treatments.

Procedure. The five plates used

Table 1

Chemical Analysis of the Five Test Plates

Plate No.	C	Mn	Si	P	S	Cr	Ni	Mo	Sn	Cu	B	Acid Soluble Al
	Components, per cent											
1	0.27	1.50	0.44	0.020	0.023	0.32	0.05	0.16	0.014	0.17	<0.0005	0.02
2	0.23	1.24	0.36	0.033	0.028	0.29	0.08	0.41	0.015	0.13	<0.0005	0.05
3	0.25	0.96	0.55	0.030	0.046	0.47	0.44	0.41	0.016	0.18	<0.0005	0.05
4	0.40	1.69	0.47	0.022	0.022	0.10	0.04	0.41	0.027	0.25	<0.0005	0.09
5	0.32	0.86	0.34	0.046	0.038	0.54	0.44	0.37	0.008	0.18	<0.0005	0.01

Presented at a Steel Session of the Fiftieth Annual Meeting, American Foundrymen's Association, at Cleveland, May 8, 1946, this paper is based on work done for the Office of Scientific Research and Development, Contract No. OEMsr-450 with Battelle Memorial Institute.

This is Part 1 of an investigation conducted at Battelle Memorial Institute. The second and concluding installment will appear in the December issue.

for this study and their analyses are listed in Table 1. The general procedure in handling these plates was to cut coupons from each of the five 36x36x2-in. plates and to homogenize them at temperatures of 1650, 1750, 1850, 1950, or 2050° F. for 2, 6, or 12 hr., and at 2250° F. for 12 hr. The latter heat treatment was given after the tests on all the other heat-treated bars had been completed. Because of its severity, it cannot be classed as a commercial heat treatment, but was included for comparison purposes.

In the discussion, the results obtained from this homogenizing heat treatment are generally considered separately from those obtained after the other homogenizing heat treatments. After an end-quench hardenability specimen and specimens for micro- and macro-examination were removed from each coupon, the remainder of the coupon was reheated to the austenitizing temperature and water quenched and tempered to 240 to 260 Brinell.

Cooling Rate

Part of each coupon was water quenched from the tempering temperature and the other part was furnace cooled to determine the effect of cooling rate from the tempering temperature on the notched-bar toughness (temper-brittleness susceptibility). Charpy-type V-notch specimens were removed from the furnace-cooled part of the coupon, while Charpy-type V-notch, Izod, and tensile specimens were taken from the water-quenched portion.

Each of the original plates was cut into at least 19 coupons, measuring 5¾x7 in. A sketch of a sample layout is given in Fig. 1. All of the plates were sectioned in essentially the same manner. The numbering system in the figures identifies the position of each coupon in the original plate.

Location of the test specimens in each coupon is shown in Fig. 2. Beginning at the left side of the sketch, the test specimens are located as tabulated below the sketch. It should be noted that as far as possible the specimens were taken from material near the surface of the coupons, reducing the probability of having porous areas in the specimens.

The coupons received the homogenizing heat treatments in an electric resistance furnace with no attempt made to control the atmosphere. They were then air cooled. After homogenizing, the coupons had a portion removed which was large enough for the machining of an end-quench bar, two fracture grain-size bars and a macro- and micro-specimen (right-hand portion shown in Fig. 2).

The remainder of each coupon was held for 4 hr. at 1600° F. in a metal box sealed with a graphite lid, removed, and then water quenched, using a submerged spray. The time in the quenching medium was 1¾ to 2 min. After this time interval, the coupon was cold enough to be removed from the fixture by hand.

One coupon from each plate was quenched without receiving previous homogenizing treatment, thus providing test specimens for unhomogenized material. Each of the as-quenched coupons was cut into two portions, and after tempering both portions of each coupon to the 240 to 260 Brinell range, one portion was water quenched after the draw (left-hand portion in Fig. 2) and the other was furnace cooled (center portion in Fig. 2).

To obtain accurate hardness measurements during the heat-treating operations, as-quenched hardness readings were taken on a surface ground below the decarburized layer. This surface was also used for measuring the hardness in tempering the coupons to the 240 to 260 Brinell range.

At the completion of the tempering operations, a minimum of 1/16 in. was shaped off the cope and drag

The effects of homogenizing heat treatments of 2, 6, or 12 hr. at 1650, 1750, 1850, 1950, or 2050° F. and of 12 hr. at 2250° F. on the hardenability and mechanical properties of five hardened and tempered commercial 2-in. cast plates from five different producers were determined. The plates varied in hardenability from one air-hardening type to two plates which did not harden fully through the 2-in. section. No significant effects or trends from the homogenizing treatments were observed on the austenitic (fracture) grain size, hardenability, notch-bar toughness on V-notch Charpy specimens at room and sub-atmospheric temperatures, temper-brittleness susceptibility, or tensile properties. The properties of unhomogenized specimens were generally equivalent to those from homogenized material. Any deviations that arose could be more closely connected to the position of the test pieces in the original plate than with any influence of the homogenizing heat treatment. The position of the test pieces in the original plate was important because variations in soundness of the castings from one part to another were reflected in the mechanical properties. Successive increases in temperature or holding time brought about a gradual diffusion of the dendritic pattern on etched macrospecimens; however, even the most drastic heat treatment did not obliterate the structure. Segregated areas in the microstructure, represented by nonuniform etching rates and nonuniform distribution of the microconstituents, were also broken up by the more drastic heat treatments in three of the steels. The effect was noticeable to a lesser degree in the fourth steel and completely absent in the fifth. Despite these changes in the appearance of the homogenized structure, after quenching and tempering no difference could be observed in the microstructure in even the extreme conditions of no homogenization whatsoever and a treatment of 12 hr. at 2250° F. It was generally concluded that, in the case of these five low-alloy steels, the various homogenizing treatments produced no appreciable change in the characteristics of the hardened and tempered specimens.

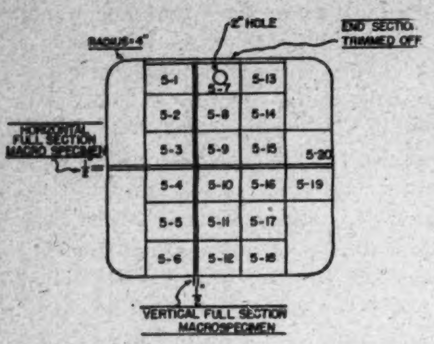


Fig. 1—Typical layout of test coupons on the cast plates. Cope side of Plate 5 is illustrated.

surfaces of the coupons to remove the decarburized layer before cutting out any of the specimens.

Some difficulty was experienced with quenching cracks in coupons from Plate 4. An interrupted quench was tried as a means of eliminating the cracks, but this treatment was not entirely successful. No further cracking was encountered when the coupons were quenched 1½ min., followed immediately by a draw at 600° F. Table 2 gives the complete heat-treating data.

A V-notch Charpy-type bar was chosen for the notched-bar tests over a temperature range of —60 to +75° F. The bars were notched on the side facing the center of the plate to include as much of the sound steel as possible within the cross section below the V.

Testing temperatures from 0° F. to —60° F. were obtained with a mixture of commercial acetone and dry ice. Specimens were held at the testing temperature for a minimum of 15 min. An interval of 5 sec. was used between the time the specimen was removed from the bath and the time the hammer was permitted to fall. To allow for heat absorption by the specimen during this 5-sec. interval, the bath was under-cooled for the various temperatures as follows:

Undercool, °F.	*Testing Temperature, °F.*
2	0
3	—20
3	—40
4	—60

Duplicate test specimens were broken at each of the testing temperatures. These duplicate specimens represented the cope and drag side of the plate.

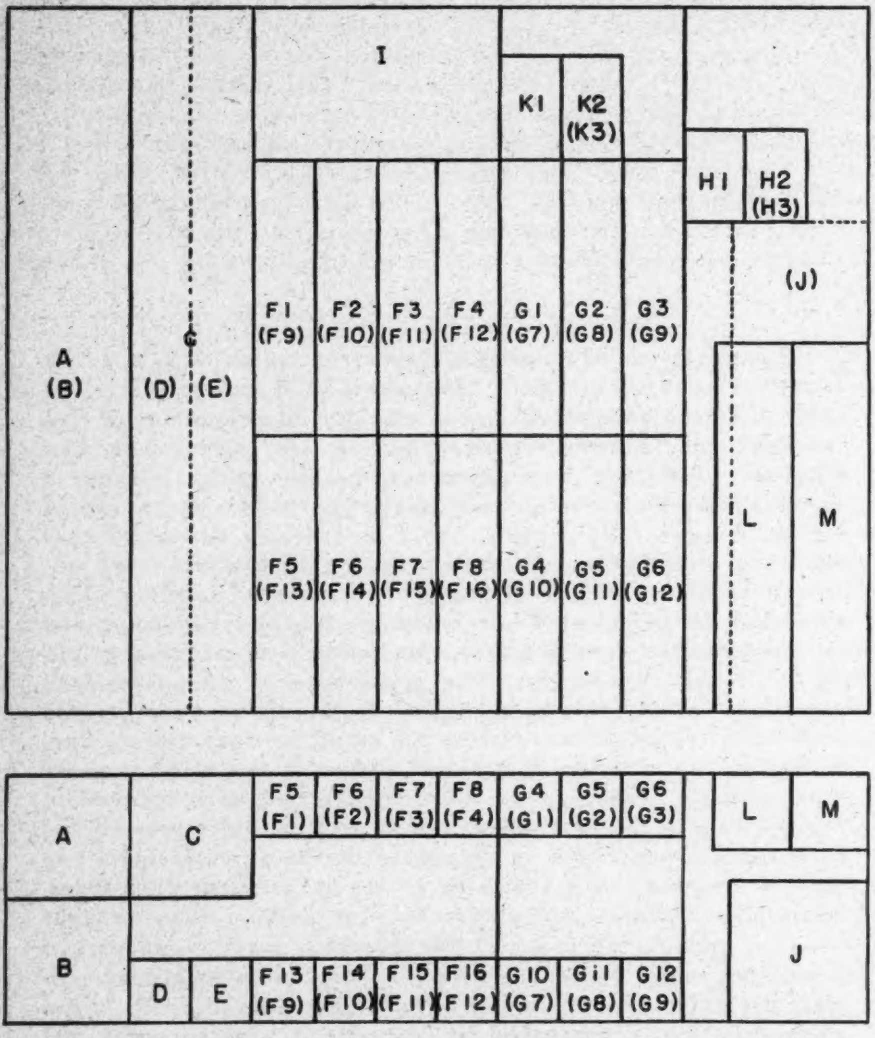
Besides the tests on the Charpy-type bars, two standard triple-notch Izod bars were tested at room temperature. These bars were cut from sections D and E shown in Fig. 2.

Sections A, B, and C in Fig. 2 were machined into standard 0.505-in. diameter, 2-in. gage length, tensile bars. These bars were tested with a load application rate of 5,000 lb. per min. A Baldwin-Southwark, Templin type, automatic-recording extensometer was used to obtain a stress-strain curve for determining the yield load at 0.2 per cent strain.

Cross-section macrospecimens, measuring the full length and width of the 36x36-in. plates, were taken from each of the five plates in the as-received condition. Smaller cross-section macrospecimens were taken from each coupon after it had received its particular homogenizing treatment, and also after it had been quenched and tempered (Kl and Hl bars in Fig. 2).

All of the macrospecimens were etched in a solution of 50 per cent water, 38 per cent hydrochloric acid and 12 per cent sulphuric acid, which was heated to 170° F. The time required to produce a satisfactory etch was about 30 min.

Examination of the macrospeci-



Portion of Coupon Water Quenched from Tempering Temperature

Tensile bars	A, B, and C
Izod bars	D, E
Charpy bars	F1 to F16
Hardness-survey block	I

Portion Furnace Cooled from Tempering Temperature

Charpy bars	G1 to G12
Macrospecimen	K1
Microspecimens	K2 and K3
Fracture grain-size bar	M

Specimens Homogenized Only

Macrospecimen	H1
Microspecimens	H2 and H3
Fracture grain-size bar	L
Jominy bar	J

Fig. 2—Detail of sectioning of each 5¾x7-in. coupon. Numbers in parenthesis are numbers of specimens directly below or behind the specimens shown in the drawing.

Table 2

TEMPERING TREATMENTS AND HARDNESSES OBTAINED ON ALL COUPONS

Coupon* Number	As-Quenched Bhn.	Final Draw hr.	Final Draw ° F.	Brinell Hardness No. Water Quenched from Draw	Brinell Hardness No. Furnace Cooled from Draw
HOMOGENIZING TREATMENT—NONE					
1-9	448	1	1200	239	245
1-13	467	1	1200	250	230
2-13	441	¼	1250	252	240
3-9	477	½	1250	256	246
4-9	514	¾	1250	255	248
5-19	507	1⅓	1250	256	242
HOMOGENIZE, 2 HR. AT 1650° F.					
1-7	415	2	1150	250	241
2-1	451	3	1200	259	241
3-1	451	½	1250	248	248
4-21**	485	1	1250	257	253
5-13	495	1	1250	259	246
HOMOGENIZE, 6 HR. AT 1650° F.					
1-14	457	1	1200	253	240
2-14	391	2	1150	259	256
3-14	451	½	1250	253	245
4-22**	471	1	1250	257	255
5-14	477	1	1250	256	253
HOMOGENIZE, 12 HR. AT 1650° F.					
1-2	415	2	1150	250	241
2-2	444	2	1200	259	241
3-2	454	½	1250	253	248
4-19**	477	¾	1250	257	246
5-2	485	1	1250	246	241
HOMOGENIZE, 2 HR. AT 1750° F.					
1-18	461	1	1200	252	252
2-18	444	2	1200	241	230
3-18	451	¾	1250	250	241
4-18	485	¾	1250	255	245
5-18	488	¾	1250	241	242
HOMOGENIZE, 6 HR. AT 1750° F.					
1-12	477	1	1200	259	256
2-12	444	2¾	1200	241	248
3-12	457	½	1250	256	246
4-12	471	½	1250	259	260
5-12	477	1	1250	255	242
HOMOGENIZE, 12 HR. AT 1750° F.					
1-3	444	1	1200	244	255
2-3	432	2	1200	256	244
3-3	474	½	1250	255	242
4-3	526	¾	1250	257	246
5-3	477	1	1250	255	252
HOMOGENIZE, 2 HR. AT 1850° F.					
1-17	451	2	1150	256	249
2-17	448	3	1200	257	246
3-17	474	½	1250	255	244
4-24**	477	1	1250	255	244
5-17	481	½	1250	257	250
HOMOGENIZE, 6 HR. AT 1850° F.					
1-11	461	1	1200	255	250
2-11	454	3½	1200	259	245
3-11	444	½	1250	250	245
4-11	492	¾	1250	248	249
5-11	488	1	1250	256	245
HOMOGENIZE, 12 HR. AT 1850° F.					
1-4	435	1	1200	252	245
2-4	415	2	1200	241	241
3-4	451	½	1250	255	255
4-4	514	¾	1250	240	241
5-4	451	1	1250	248	241
HOMOGENIZE, 2 HR. AT 1950° F.					
1-16	467	2	1150	256	245
2-16	451	2	1200	252	245
3-16	454	½	1250	255	260
4-23**	485	1	1250	253	253
5-16	477	1	1250	245	240
HOMOGENIZE, 6 HR. AT 1950° F.					
1-10	448	1	1200	255	249
2-10	406	1¾	1200	240	248
3-10	454	½	1250	255	242
4-10	503	¾	1250	245	249
5-10	467	1	1250	253	255
HOMOGENIZE, 12 HR. AT 1950° F.					
1-5	444	1	1200	250	248
2-5	426	2	1200	255	244
3-5	448	½	1250	257	250
4-5	454	½	1250	244	255
5-5	415	¾	1250	244	245
HOMOGENIZE, 2 HR. AT 2050° F.					
1-15	481	1¾	1200	252	249
2-15	385	2	1200	250	244
3-15	464	½	1250	253	255
4-15	551	¾	1250	248	242
5-15	474	1	1250	255	241
HOMOGENIZE, 6 HR. AT 2050° F.					
1-8	406	¾	1200	241	243
2-8	406	2	1200	253	242
3-8	417	½	1250	255	255
4-20**	467	¾	1250	256	255
5-8	467	1	1250	249	242
HOMOGENIZE, 12 HR. AT 2050° F.					
1-6	415	1	1200	242	244
2-6	411	2	1200	250	236
3-6	420	½	1250	249	255
4-6	448	½	1250	248	255
5-6	444	¾	1250	241	242

**Six coupons from No. 4 Plate are replacements for those which were badly cracked after being quenched. These six replacements were given a 1½-min. water quench and an immediate draw of one hour at 600° F. The value in the "As-Quenched Bhn." column was obtained after this preliminary draw.

*The first number is the plate number. The second number is the coupon number.

mens taken from the material that had been quenched and tempered did not show anything that could not be seen in the as-homogenized macrospecimens, hence the quenched and tempered specimens were not photographed.

Microspecimens were taken from each plate in the as-received condition, and from each coupon after the homogenizing treatment and after the quenching and tempering treatment. The specimens were selected to present a cross-section surface extending from the center to the cope side of the plates.

Specimens taken from the various coupons after homogenizing were photographed at ×100 in the etched condition, at a spot ½ in. below the cope surface. Only representative photographs of these specimens are illustrated in this report. Examination of the microspecimens of the coupons after quenching and tempering showed so little variation that only the specimens that had received the most drastic homogenizing treatment and those that had received no homogenizing treatment were photographed.

Grain Size Determinations. The fracture grain-size bars ("M" bar in

Table 3

FRACTURE GRAIN SIZES OBTAINED ON WATER-QUENCHED BARS HEATED WITH THE COUPONS TO 1600° F. AND HELD 4 HR.

Homogenizing Time, hr.	Homogenizing Temperature, ° F. 1650	1750	1850	1950	2050	2250
PLATE NO. 1—GRAIN SIZE BEFORE HOMOGENIZING—6						
2	6½	6½	6½	6½	6½	—
6	6½	6½	6½	6½	6½	—
12	6½	6½	6½	6½	6½	7
PLATE NO. 2—GRAIN SIZE BEFORE HOMOGENIZING—7						
2	6½	6½	6½	6½	6½	—
6	6½	6½	6½	5½	6½	—
12	6½	5½	6½	6½	6½	6
PLATE NO. 3—GRAIN SIZE BEFORE HOMOGENIZING—5½						
2	5-7 Mixed	5-7 Mixed	5-7 Mixed	5-7 Mixed	5-7 Mixed	—
6	5-7 Mixed	5-7 Mixed	5-7 Mixed	5-7 Mixed	5-7 Mixed	—
12	5-7 Mixed	5-7 Mixed	5-7 Mixed	5-7 Mixed	5-7 Mixed	5½
PLATE NO. 4—GRAIN SIZE BEFORE HOMOGENIZING—7						
2	6½	6	6	5½	6	—
6	6½	6	5½-6½	5½	5½	—
12	6½	6	5½	6	6	7-0 Mixed
PLATE NO. 5—GRAIN SIZE BEFORE HOMOGENIZING—4						
2	2½	3	2½	2	2½	—
6	2½	2½	2 & 7	2 & 7	2½	—
12	2	1½ & 8	2	2	2½	4½

Table 4

FRACTURE GRAIN SIZES OBTAINED ON END-QUENCH BARS

(All bars quenched from 1600° F. after holding 20 min.)

Homogenizing Time, hr.	Homogenizing Temperature, ° F. 1650	1750	1850	1950	2050	2250
PLATE NO. 1—GRAIN SIZE BEFORE HOMOGENIZING—6						
2	7	6½	6	5½	5½	—
6	7	6	6½	6	6	—
12	6	7	5½	6	6	6
PLATE NO. 2—GRAIN SIZE BEFORE HOMOGENIZING—6						
2	6½	6	6	6	6	—
6	6	6½	6	5½	5½	—
12	6½	5½	5½	5	7	6
PLATE NO. 3—GRAIN SIZE BEFORE HOMOGENIZING—7						
2	6	5½	5	5	5	—
6	5½	5	5	5	5	—
12	5½	5	5	5½	5	6
PLATE NO. 4—GRAIN SIZE BEFORE HOMOGENIZING—7						
2	7	7½	7	6	6½	—
6	7½	7½	7½	7	6	—
12	7	7	7	7	7½	7-0 Mixed
PLATE NO. 5—GRAIN SIZE BEFORE HOMOGENIZING—5						
2	5	5	4	5½	5	—
6	4½	4	4	4	4½	—
12	4½	4	4	4½	4½	5

Fig. 2) cut from each coupon were given the same treatment as the coupons, namely, 4 hr. at 1600° F., followed by a water quench. The fractures of the broken bars were compared with a set of Shepherd standard fractures and the grain size rated.

Exclusive of the data for the 2250° F. homogenize, the results in Table 3 show that Plate 5 was the only plate to have a coarse austenitic grain size after holding for 4 hr. at 1600° F. before water quenching. The steel in this plate was understood to have been deoxidized with silicon only.

Plates 1, 2, 3, and 4 had a much finer grain size, ranging from No. 5 to No. 7. Plate 3, which was understood to have been deoxidized with an intermediate amount of aluminum (under 1 lb. Al per ton), consistently showed a mixed grain size of No. 5 and No. 7, except in the coupons which received no homogenizing treatment. This coupon had a grain size of No. 5½.

Plates 1, 2, and 4 were understood to have been deoxidized with at least 2 lb. Al per ton. It will be noted that although the various homogenizing treatments established no noticeable trend in grain size, the coupon which received no homogenizing treatment had a tendency toward a finer grain size than the coupons receiving the treatments. This trend is exhibited in Plates 2, 4, and 5.

Further, steels from Plates 1, 2, and 4, deoxidized with a minimum of 2 lb. Al per ton, tended to have a finer grain size than either steel from Plate 3, deoxidized with an intermediate aluminum addition, or the silicon-deoxidized steel from Plate 5. The grain-size characteristics of the steel were in accordance with those expected from the deoxidization practices employed.

Grain Size Changes

Table 3 shows that the more noticeable changes in grain size resulting from the 2250° F. homogenizing heat treatment took place in the coupons from Plates 3, 4, and 5. The effect of this treatment on Plate 4 is the most outstanding since it produced a mixed grain of Nos. 7 and 0. The low grain-coarsening temperature indicated by this mixed grain is unusual for an aluminum-killed steel quenched from 1600° F.

Additional fracture grain-size bars ("L" bar in Fig. 2) were heated and quenched with the hardenability bars, but because of the difficulty in achieving the same rate of heating for these fracture grain-size bars that was obtained with the end-quench bars, and because of the differences in holding time, the grain size of the fracture grain-size bars did not always match the grain size found in the hardenability bars receiving a similar preliminary heat treatment.

Herty and coworkers[1] have discussed the effect of heating rate on austenitic grain size. Their work indicated that, in certain instances, heating quickly through the transformation range increased the aus-

Table 5
End-Quench Hardenability Data

Homogenizing Treatment — Temperature, °F.	Homogenizing Treatment — Time, hr.	Coupon No.	Rockwell "C" 1/16 in. from Quenched End	Distance from Quenched End (1/16 in.) for Drop of 5 Rockwell "C"	Distance from Quenched End (1/16 in.) for Drop of 10 Rockwell "C"	Rockwell "C" at 40/16 in. from Quenched End
Plate No. 1						
None	None	1-9	50	4.4	6.1	27
1650	2	1-7	49	4.2	5.7	25
1650	6	1-14	49	4.1	5.8	25
1650	12	1-2	49½	4.3	6.1	27½
1750	2	1-18	49	4.3	5.9	24
1750	6	1-12	49½	3.9	5.6	24½
1750	12	1-3	49½	4.6	6.6	27½
1850	2	1-17	49½	4.3	6.3	25½
1850	6	1-11	49	4.0	5.6	26½
1850	12	1-4	48½	4.9	6.5	25
1950	2	1-16	49	4.2	5.9	25½
1950	6	1-10	49	3.5	4.8	24
1950	12	1-5	49	3.6	5.1	25
2050	2	1-15	50	3.6	5.2	25
2050	6	1-8	48	4.1	5.6	24½
2050	12	1-6	49	4.2	5.8	25
2250	12	1-19	48½	4.3	5.7	23
Plate No. 2						
None	None	2-13	48½	4.0	5.6	27
1650	2	2-1	47½	3.4	4.7	24
1650	6	2-14	48	3.7	5.0	25
1650	12	2-2	46	4.3	5.8	25
1750	2	2-18	47½	4.3	5.6	24
1750	6	2-12	47½	4.5	5.9	24½
1750	12	2-3	45½	3.6	5.0	22½
1850	2	2-17	48	4.1	5.6	24
1850	6	2-11	47	4.8	6.6	24½
1850	12	2-4	45½	4.1	5.7	21
2050	2	2-15	47	4.4	5.9	23½
2050	6	2-8	47	4.4	6.1	23
2050	12	2-6	46	4.2	6.0	23½
2250	12	2-19	45	4.6	6.1	23
Plate No. 3						
None	None	3-9	49½	9.0	14.2	31½
1650	2	3-1	48½	8.7	12.7	29
1650	6	3-14	49	9.5	14.2	31
1650	12	3-2	48½	8.5	12.6	28
1750	2	3-18	49	8.6	13.4	31
1750	6	3-12	49	7.8	11.7	30½
1750	12	3-3	49	8.9	13.5	31
1850	2	3-17	49½	7.8	11.0	29½
1850	6	3-11	49	8.8	13.0	31
1850	12	3-4	49½	8.8	13.4	31
1950	2	3-16	49	9.1	13.7	31½
1950	6	3-10	48	9.4	14.4	30
1950	12	3-5	48½	8.6	12.8	31
2050	2	3-15	49	8.3	12.5	31
2050	6	3-8	48	8.8	13.2	30½
2050	12	3-6	48	8.5	12.9	30½
2250	12	3-19	48½	7.6	10.8	26½
Plate No. 4						
None	None	4-9	58½	22.0	28.0*	50½
1650	2	4-21	58	38.0	—	58
1650	6	4-22	58	29.0	—	51½
1650	12	4-19	58	28.0	37.0*	51
1750	2	4-18	57½	24.0	32.0*	49½
1750	6	4-12	58½	26.5	34.0*	50½
1750	12	4-3	57	30.0	—	50½
1850	2	4-24	58½	27.0	39.0*	51½
1850	6	4-11	58½	23.5	—	52
1850	12	4-4	58½	28.0	38.0*	51
1950	2	4-23	57½	—	—	53½
1950	6	4-10	58	33.5	—	51½
1950	12	4-5	57	36.0	—	52
2050	2	4-15	59	26.0	—	52½
2050	6	4-20	58½	20.0	30.5*	51
2050	12	4-6	59	26.5	—	52½
2250	12	4-7	57	20.0	—	48½
Plate No. 5						
None	None	5-19	51½	7.7	10.0	31
1650	2	5-13	51½	7.8	11.2	31½
1650	6	5-14	51	8.2	11.5	31
1650	12	5-2	50	8.0	12.2	31
1750	2	5-18	51	8.1	11.3	31½
1750	6	5-12	50½	8.0	11.2	31½
1750	12	5-3	50½	7.8	11.2	30
1850	2	5-17	50	8.5	11.7	31½
1850	6	5-11	50	8.4	11.8	30
1850	12	5-4	50	8.0	10.8	30
1950	2	5-16	51	8.5	11.6	31½
1950	6	5-10	50½	8.9	12.7	31½
1950	12	5-5	50½	9.1	12.8	31
2050	2	5-15	50½	8.5	11.6	31½
2050	6	5-8	51½	8.7	11.8	31½
2050	12	5-6	51½	8.5	11.3	30½
2250	12	5-20	51	9.5	13.0	29½

*Drop of 7 Rockwell "C"

tenite grain size, depending upon the particular deoxidization practice which was used on the steel.

To obtain correct values for the grain size of the end-quenched hardenability bars, they were deeply cut close to the quenched end and fractured in the martensitic zone. These fractures were than rated for the grain size of the bar (Table 4).

With the exception of Plates 3 and 5, the grain sizes in Tables 3 and 4 check closely. In Plate 3 the short holding time of 20 min. for the end-quench test (Table 4) was not sufficient to develop the mixed grains found after 4 hr. at temperature (Table 3). A similar explanation can be advanced for the differences in grain size of Plate 5 after the two treatments. In neither table is there an apparent trend in grain size resulting from the homogenizing heat treatments.

No great difference exists in the effects of the 2250° F. treatment as compared with the other homogenizing treatments, except in the case of Plate 4 where the mixed grain of Nos. 7 and 0 is again evident.

Hardenability Properties. The hardenability properties were investigated by means of end-quench tests,

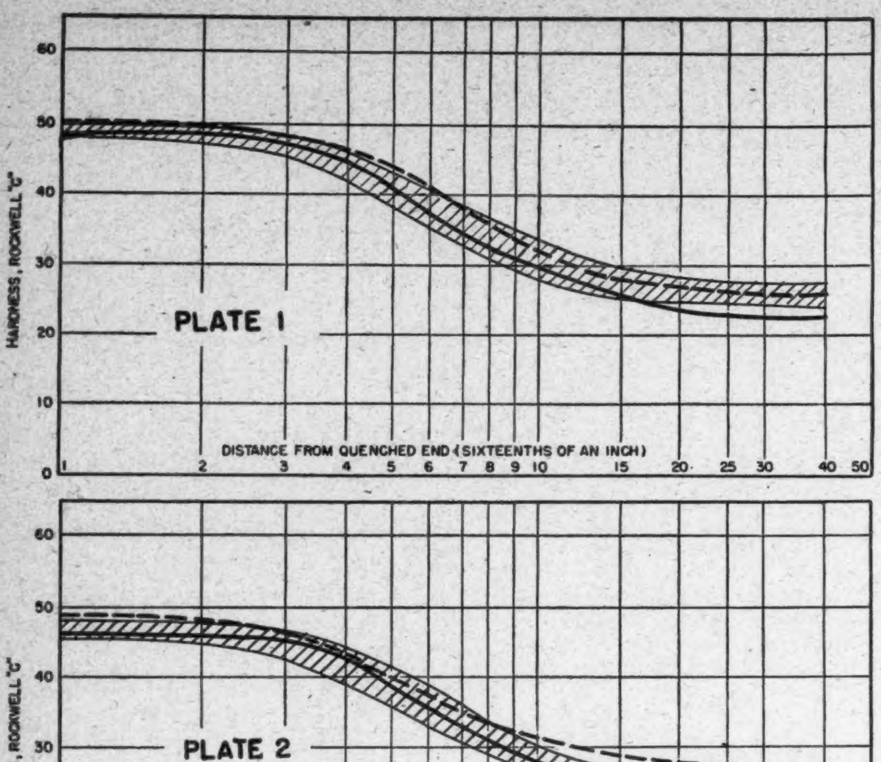


Fig. 3—(Continued on opposite page).

and cross-section hardness surveys made after quenching and tempering. The end-quench bars were the standard 3-in. long, 1-in. diameter bars. They were placed in protective graphite crucibles and heated to 1600° F. in 20 min. After holding for 20 min. at temperature, the bars were end-quenched, using the standard procedure.

The hardenability data are given in Table 5 by tabulating the hardness at 1/16 in. from the quenched end, the distances for a drop of 5 and of 10 Rockwell "C", and the hardness at 2½ in. from the quenched end. This tabulation of hardenability data in Table 5 permits a quantitative comparison of the results from each plate for each heat treatment.

It is obvious from Table 5 that homogenizing has not effected any change in the depth-hardening properties of the steels; within the limits of error, all of the bars from each steel have the same hardenability regardless of the homogenizing time or temperature.

Figure 3 shows the range of hardenability for each of the five steels after the various homogenizing heat treatments. In no case is this range broad, another indication that the homogenizing treatment has had no influence on hardenability.

The hardenability curves of the unhomogenized bars (and the bars homogenized at 2250° F. for 12 hr.) are also plotted in Fig. 3. The solid lines are the curves for the steels after homogenizing at 2250° F. for 12 hr., while the dashed lines are for the unhomogenized bars. The curves for the unhomogenized bars generally fall near the upper part of the range of the homogenized specimens.

It may be questioned whether this slight tendency toward higher hardenability on the part of the unhomogenized specimens was great enough to be significant. However, Parke and Herzig[2] have reported two instances where homogenization did result in lowered hardenability.

Hardenability Ratings

Hardenability of Plate 5 is increased somewhat by the 2250° F. homogenization heat treatment, but the hardenability ratings of the specimens from the other plates given the same treatment fall within the range estabished by the other homogenizing treatments. The hardenability curves show Plate 4 to be of the air-hardening type. The others have considerably lower hardenability properties.

The "I" block (Fig. 2) was used to reveal the total effect of quenching and tempering on the hardness distribution through the cross section of each coupon. These hardness distribution curves are plotted in Figs. 4 to 8, and the tables opposite the corresponding curves list the pertinent heat-treating data and surface hardness of each coupon.

No correlation can be made between the homogenizing treatments and the cross-section hardness surveys because the cross-sectional hardness appears to be influenced more by the position of the coupon in the original plate than by the homogenizing heat treatment. The cross-section hardness surveys instead give a picture of the hardness distribution which is characteristic of that

particular part of the original plate from which the section was removed. They also provide a means of evaluating more accurately the hardness of the test bars which were removed from the coupons.

Note that Plate 1 (Fig. 4) shows a decided dip, Plate 2 (Fig. 5) a shallow dip, while Plates 3, 4, and 5 (Figs. 6, 7, and 8) have fairly flat curves. It may be deduced that Plates 1 and 2, since the hardenability curves (Fig. 3) show them to be of considerably lower hardenability than the rest of the plates, were never thoroughly hardened to the center and that the tempering treatment did not completely even out the differences in hardness from surface to center.

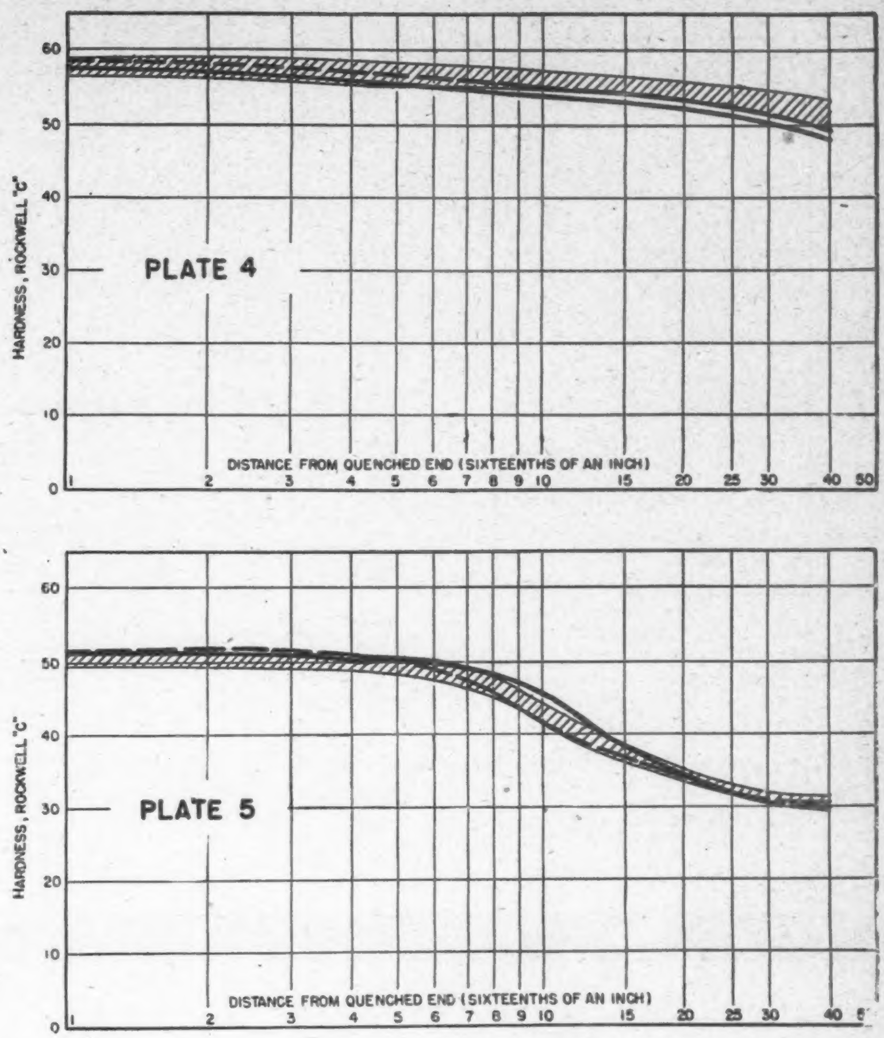
It is not unusual that Plates 1 and 2 did not harden fully since tests on submerged spray quenching used in this work have shown that the cooling rate at the center of a 2-in. plate is equivalent to that at 11/16 in. from the quenched end of an end-quench bar. Figure 3 shows that both Plates 1 and 2 had low hardnesses at this point.

Low-Temperature Notched-Bar Tests. A property required for certain applications is ability to withstand shock, not only at room temperatures but under subzero conditions as well. For this reason, a study of the toughness of the five steels as affected by the various homogenizing heat treatments was made a part of the research work.

Low-Temperature Properties

Closely allied with the study of low-temperature properties is the problem of temper-brittleness susceptibility, which is a latent factor whenever alloy steels are used after quenching and drawing. Temper brittleness is manifested by a loss in toughness after a tempering treatment which is followed by slow cooling to room temperature. It can be repressed by rapid cooling after tempering or by controlling the composition; the use of molybdenum is effective in this respect.

The study of temper-brittleness susceptibility was incorporated with the determination of low-temperature toughness by preparing duplicate sets of test bars, one set being taken from a portion of the coupon that had been water quenched after tempering and the other set from another portion that was furnace



—— 12-hr. homogenize at 2250° F.
- - - No homogenizing treatment.
Quenching temperature, 1600° F. for all plates

Plate No.	C	Mn	Si	P	S	Cr	Ni	Mo	Sol. Al	Cu	Grain Size
1	.27	1.50	.44	.020	.023	.32	.05	.16	.02	.17	6
2	.23	1.24	.36	.033	.028	.29	.08	.41	.05	.13	6
3	.25	0.96	.55	.030	.046	.47	.44	.41	.05	.18	6-7
4	.40	1.69	.47	.022	.022	.10	.04	.41	.09	.25	7*
5	.32	0.86	.34	.046	.038	.54	.44	.37	.01	.18	5

*Grain size was 7 and 0 after 2250° F. homogenize.

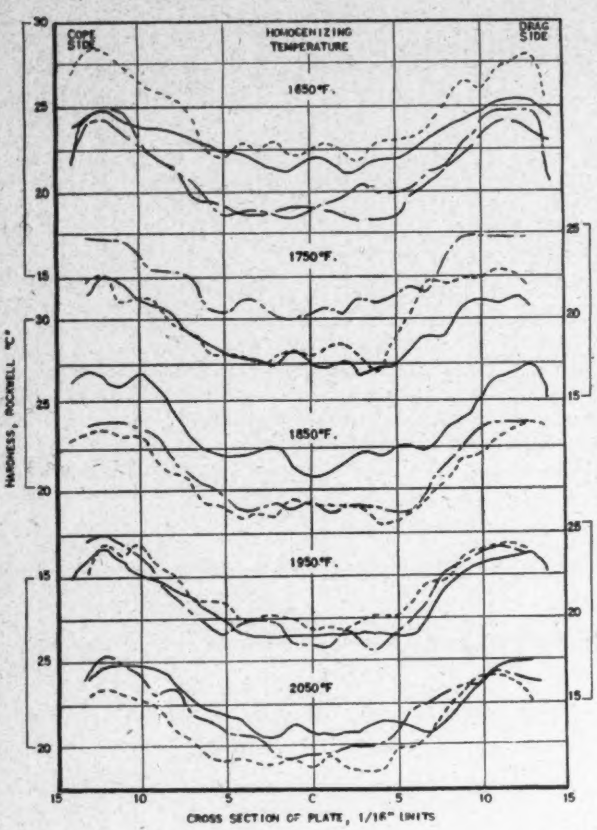
Fig. 3—Range of hardenability for each of the five steels after the various homogenizing heat treatments.

cooled at the rate of 100 to 115° F. per hr. after the final draw.

Originally, air cooling after tempering had been planned for use in revealing temper brittleness, because air cooling is common practice in the industry. However, a test on a pilot coupon proved that there was little difference in the toughness of the steel at low temperatures, whether water quenched or air cooled. This is shown by the curves in the left-hand graph in Fig. 9.

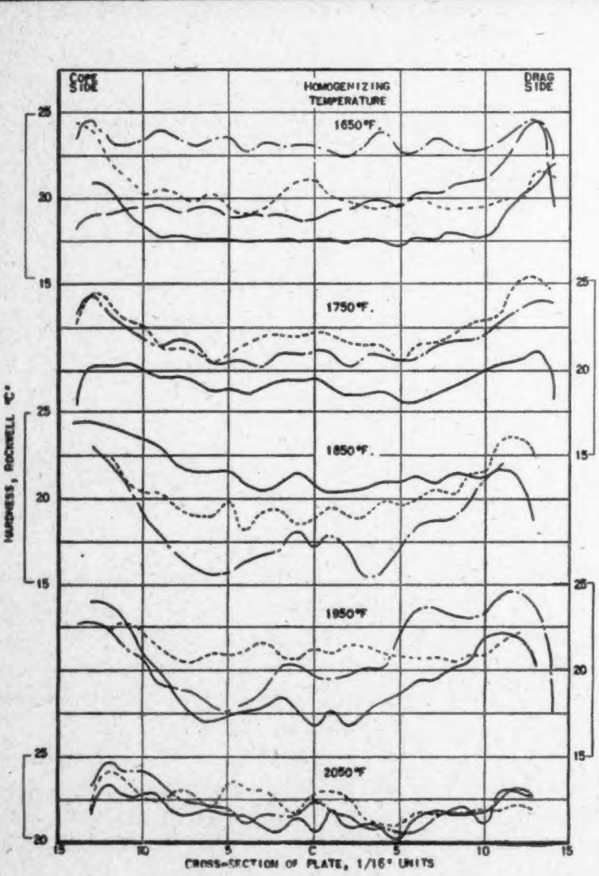
Furnace cooling rather than air cooling was therefore resorted to in an attempt to show up temper brittleness. The curves in Fig. 9 for the furnace-cooled specimens indicate that furnace cooling caused an appreciable reduction in toughness at sub-atmospheric temperatures. These results led to the adoption of furnace cooling instead of air cooling for all the coupons.

Actually, furnace cooling of the relatively small test coupons at the



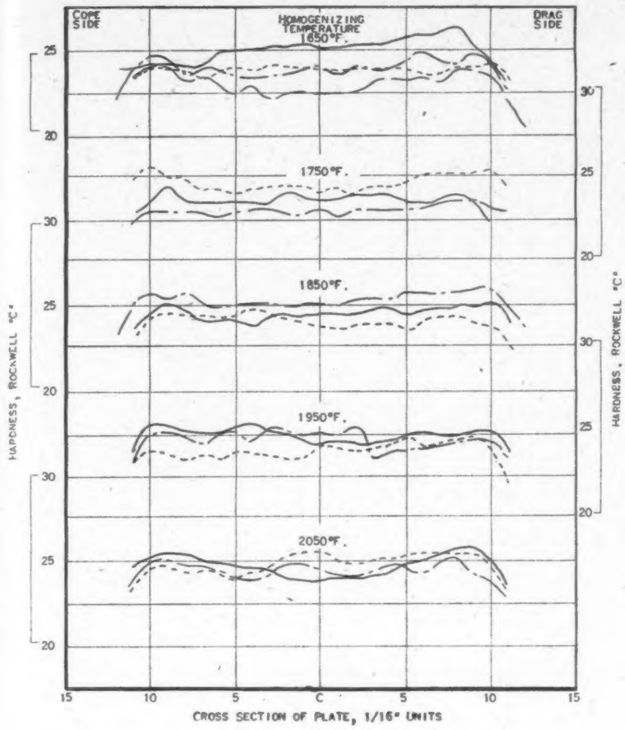
Coupon No.	Homogenizing Treatment, Hr.	° F.	As-Quenched Bhn.	Drawing Treatment, Hr.	° F.	As-Drawn Bhn. Cope	Drag	Code
1650° F. Homogenize								
1-9	None		448	1	1200	242	232	— —
1-7	2	1650	415	2	1150	250	249	——
1-14	6	1650	457	1	1200	244	231	— - —
1-2	12	1650	415	2	1150	259	256	- - - - -
1750° F. Homogenize								
1-18	2	1750	461	1	1200	248	245	——
1-12	6	1750	477	1	1200	257	248	— - —
1-3	12	1750	444	1	1200	244	231	- - - - -
1850° F. Homogenize								
1-17	2	1850	451	2	1150	256	253	——
1-11	6	1850	461	1	1200	245	244	— - —
1-4	12	1850	435	1	1200	224	245	- - - - -
1950° F. Homogenize								
1-16	2	1950	467	2	1150	241	245	——
1-10	6	1950	448	1	1200	250	232	— - —
1-5	12	1950	444	1	1200	239	236	- - - - -
2050° F. Homogenize								
1-15	2	2050	481	1	1200	241	239	——
1-8	6	2050	406	¾	1200	231	234	— - —
1-6	12	2050	415	1	1200	246	229	- - - - -

Fig. 4—Effect of homogenizing treatments on the hardness distribution within the cross section of quenched and drawn coupons from Plate No. 1



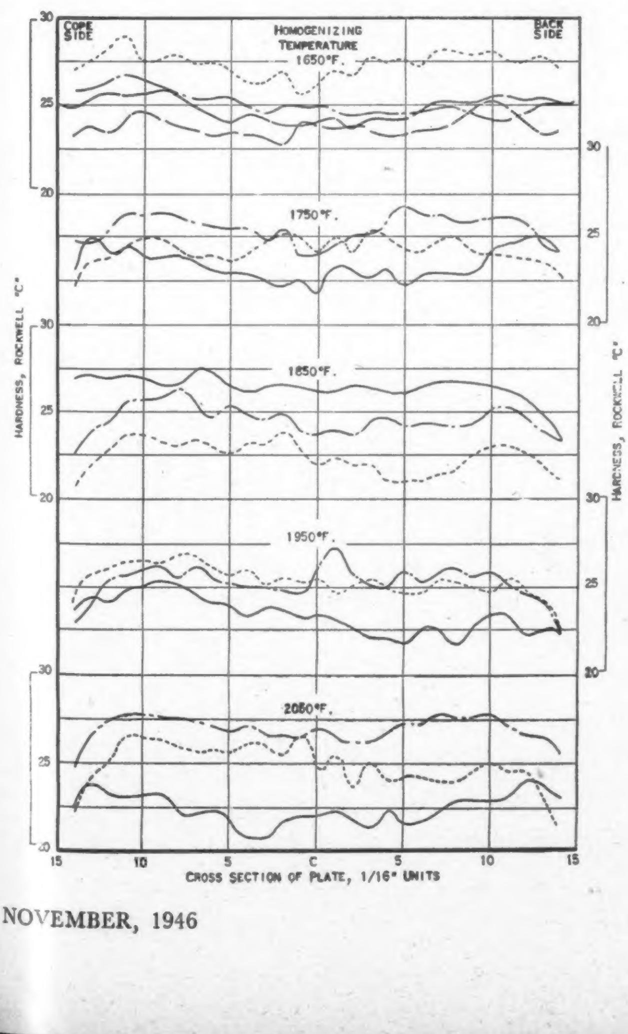
Coupon No.	Homogenizing Treatment, Hr.	° F.	As-Quenched Bhn.	Drawing Treatment, Hr.	° F.	As-Drawn Bhn. Cope	Drag	Code
1650° F. Homogenize								
2-13	None		441	¼	1250	245	253	— —
2-1	2	1650	451	3	1200	232	255	——
2-14	6	1650	391	2	1150	269	250	— - —
2-2	12	1650	444	¼	1250	252	248	- - - - -
1750° F. Homogenize								
2-18	2	1750	444	2	1200	232	217	——
2-12	6	1750	444	2¾	1200	256	241	— - —
2-3	12	1750	432	2	1200	255	219	- - - - -
1850° F. Homogenize								
2-17	2	1850	448	3	1200	255	246	——
2-11	6	1850	454	3½	1200	241	235	— - —
2-4	12	1850	415	2	1200	245	229	- - - - -
1950° F. Homogenize								
2-16	2	1950	467	2	1150	253	215	——
2-10	6	1950	406	1¾	1200	255	229	— - —
2-5	12	1950	426	2	1200	242	237	- - - - -
2050° F. Homogenize								
2-15	2	2050	385	2	1200	255	234	——
2-8	6	2050	406	2	1200	242	250	— - —
2-6	12	2050	411	2	1200	240	226	- - - - -

Fig. 5—Effect of homogenizing treatments on the hardness distribution within the cross section of quenched and drawn coupons from Plate No. 2



Coupon No.	Homogenizing Treatment, Hr.	°F.	As-Quenched Bhn.	Drawing Treatment, Hr.	°F.	As-Drawn Bhn. Cope	Drag	Code
1650° F. Homogenize								
3-9	None		477	½	1250	248	217	— —
3-1	2	1650	451	½	1250	252	241	——
3-14	6	1650	451	½	1250	260	237	— · —
3-2	12	1650	454	½	1250	255	224	- - - - -
1750° F. Homogenize								
3-18	2	1750	451	¾	1250	241	239	——
3-12	6	1750	457	½	1250	245	242	— · —
3-3	12	1750	474	½	1250	245	234	- - - - -
1850° F. Homogenize								
3-17	2	1850	474	½	1250	241	245	——
3-11	6	1850	444	½	1250	241	250	— · —
3-4	12	1850	451	½	1250	235	245	- - - - -
1950° F. Homogenize								
3-16	2	1950	454	½	1250	255	253	——
3-10	6	1950	454	½	1250	244	232	— · —
3-5	12	1950	448	½	1250	248	235	- - - - -
2050° F. Homogenize								
3-15	2	2050	464	½	1250	259	250	——
3-8	6	2050	417	½	1250	248	248	— · —
3-6	12	2050	420	½	1250	255	239	- - - - -

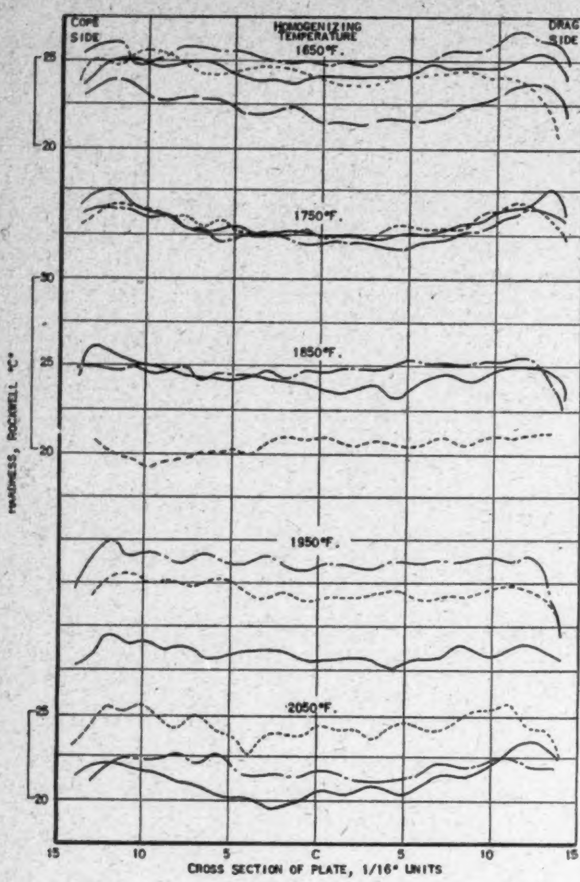
Fig. 6—Effect of homogenizing treatments on the hardness distribution within the cross section of quenched and drawn coupons from Plate No. 3.



Coupon No.	Homogenizing Treatment, Hr.	°F.	As-Quenched Bhn.	Drawing Treatment, Hr.	°F.	As-Drawn Bhn. Front	Back	Code
1650° F. Homogenize								
4-9	None		514	¾	1250	246	252	— —
4-21	2	1650	485*	1	1250	256	255	——
4-22	6	1650	471*	1	1250	269	255	— · —
4-19	12	1650	477*	¾	1250	256	248	- - - - -
1750° F. Homogenize								
4-18	2	1750	485	¾	1250	255	253	——
4-12	6	1750	471	½	1250	255	255	— · —
4-3	12	1750	526	¾	1250	255	246	- - - - -
1850° F. Homogenize								
4-24	2	1850	477*	1	1250	257	250	——
4-11	6	1850	492	¾	1250	241	255	— · —
4-4	12	1850	514	¾	1250	223	229	- - - - -
1950° F. Homogenize								
4-23	2	1950	485*	1	1250	255	248	——
4-10	6	1950	503	¾	1250	241	255	— · —
4-5	12	1950	454	½	1250	242	232	- - - - -
2050° F. Homogenize								
4-15	2	2050	551	¾	1250	240	241	——
4-20	6	2050	467*	¾	1250	246	248	— · —
4-6	12	2050	448	½	1250	241	237	- - - - -

*Hardness value of these replacement coupons were taken after a one-hour draw at 600° F.

Fig. 7—Effect of homogenizing treatments on the hardness distribution within the cross section of quenched and drawn coupons from Plate No. 4.



Coupon No.	Homogenizing Treatment, Hr.	Homogenizing Treatment, ° F.	As-Quenched Bhn.	Drawing Treatment, Hr.	Drawing Treatment, ° F.	As-Drawn Bhn. Cope	As-Drawn Bhn. Drag	Code
1650° F. Homogenize								
5-19	None		507	1⅛	1250	252	242	— —
5-13	2	1650	495	1	1250	255	255	——
5-14	6	1650	477	1	1250	262	255	— · —
5-2	12	1650	485	1	1250	247	237	- - - - -
1750° F. Homogenize								
5-18	2	1750	488	¾	1250	241	230	——
5-12	6	1750	477	1	1250	244	235	— · —
5-3	12	1750	477	1	1250	246	242	- - - - -
1850° F. Homogenize								
5-17	2	1850	481	½	1250	252	226	——
5-11	6	1850	488	1	1250	253	240	— · —
5-4	12	1850	451	1	1250	231	229	- - - - -
1950° F. Homogenize								
5-16	2	1950	477	1	1250	241	246	— —
5-10	6	1950	467	1	1250	252	230	— · —
5-5	12	1950	415	¾	1250	244	246	- - - - -
2050° F. Homogenize								
5-15	2	2050	474	1	1250	242	242	——
5-8	6	2050	467	1	1250	245	232	— · —
5-6	12	2050	444	¾	1250	231	242	- - - - -

Fig. 8—Effect of homogenizing treatments on the hardness distribution within the cross section of quenched and drawn coupons from Plate No. 5

rate of 100 to 115° F. per hr. is probably a close approach to the cooling speed of full-size (2-in.) sections cooled in air under industrial conditions. Thus, it would seem that the data on the furnace-cooled specimens are more nearly representative of operating conditions than those from air-cooled coupons.

Since some coupons had already been air cooled from the tempering temperature before tests on the pilot coupon were completed, it was necessary to ascertain whether or not reheating of these air-cooled specimens to the tempering temperature followed by furnace cooling would in any way change the toughness values.

A glance at the two sets of curves in Fig. 9 discloses that reheating to the tempering temperature and then furnace cooling gives results that are in every way comparable to those obtained after furnace cooling directly from original draw.

The Charpy-type bar was chosen for the low-temperature notched-bar tests because it can be placed in the impact testing machine more rapidly than the Izod bar. A V-notch rather than a keyhole notch was used; however, because the V-notch, by giving a wider numerical spread in values, appears to be more sensitive to changes in the toughness of the steel, and thus would accentuate the location of a temperature-sensitive range if one were present.

Charpy results for the low-temperature tests are shown in Figs. 10 to 14, which are plotted to show the effect of the homogenizing temperature. Each point represents the average of two tests.

Considering the effects of both time and temperature on steels water quenched from the tempering temperature, comparison of the results presents no evidence that any one homogenizing heat treatment develops superior properties. Neither is there evidence of a trend in that direction. Furthermore, the position of the notch toughness-temperature curve for the unhomogenized speci-

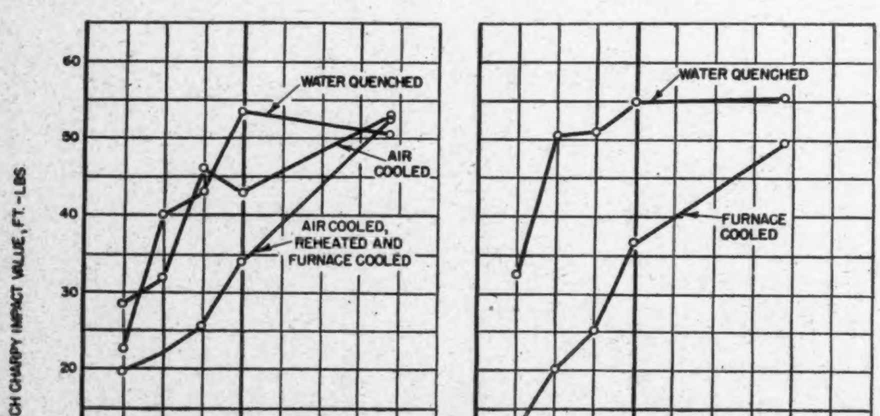


Fig. 9—Effect of cooling rate from the tempering temperature on notched-bar toughness.

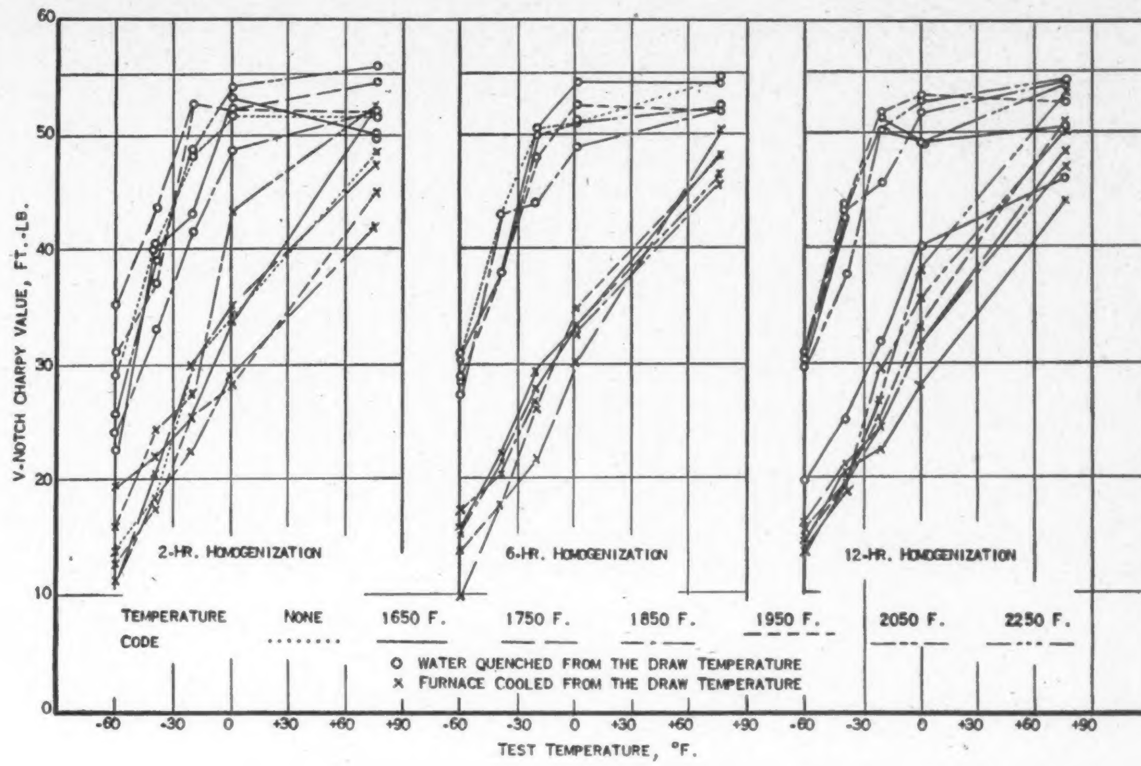
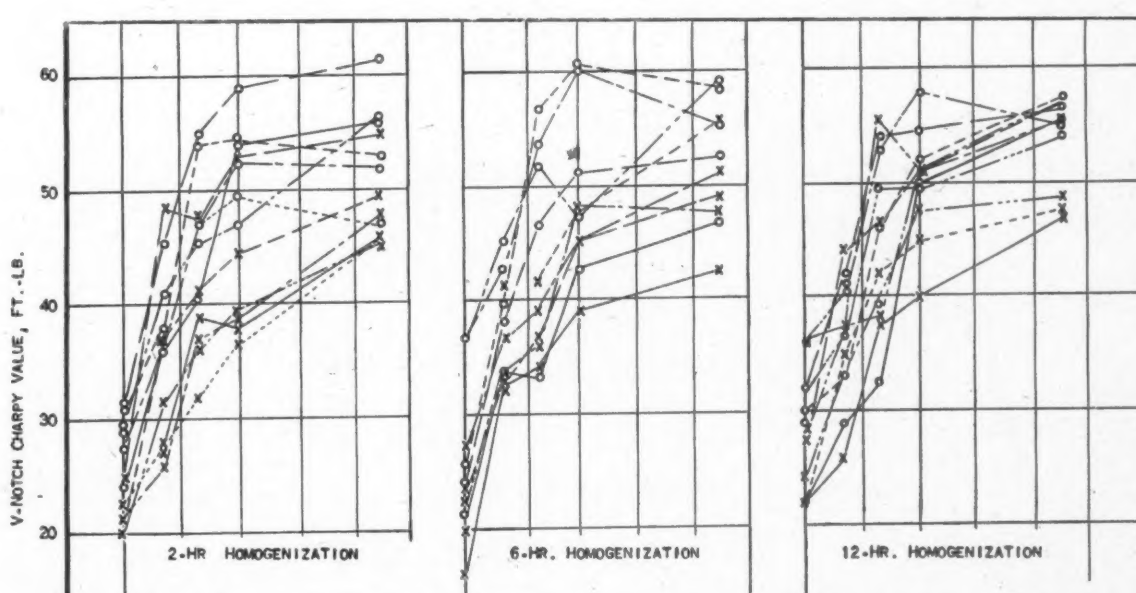


Fig. 10—Plate No. 1—Effect of homogenizing temperature on V-notch Charpy values.

Fig. 11—Plate No. 2—Effect of homogenizing temperature on V-notch Charpy values.



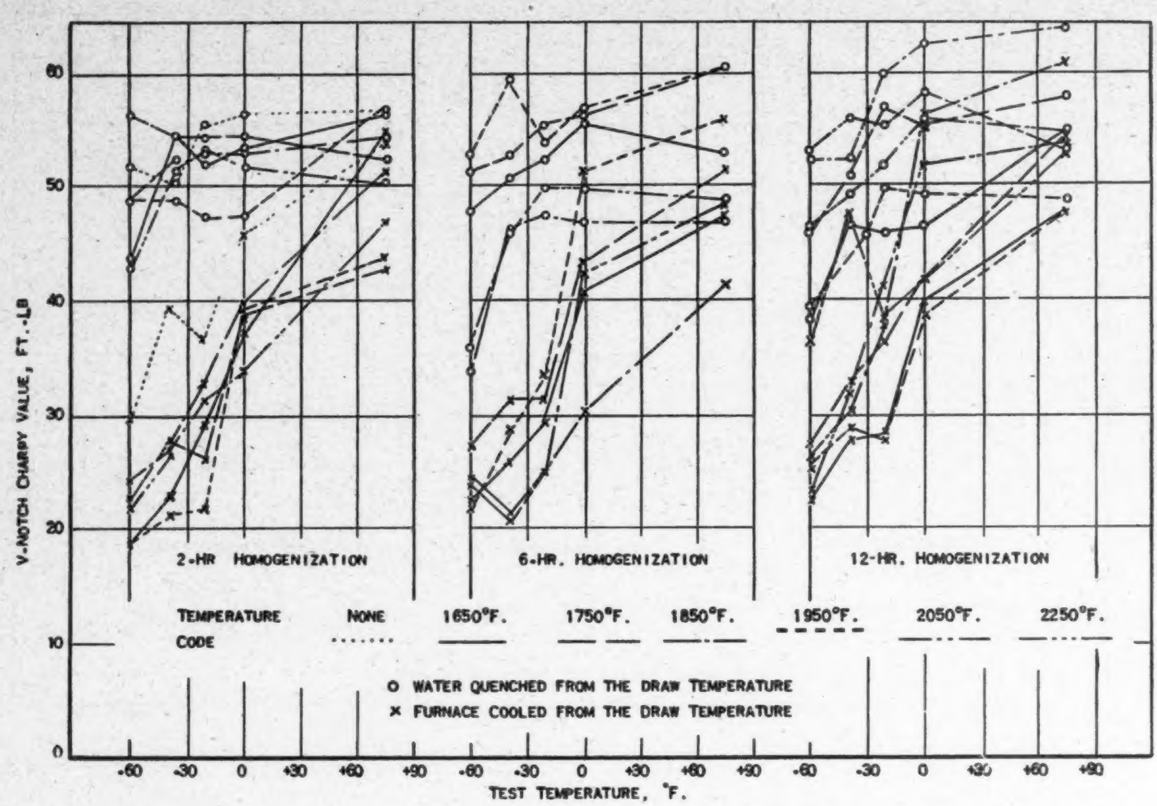
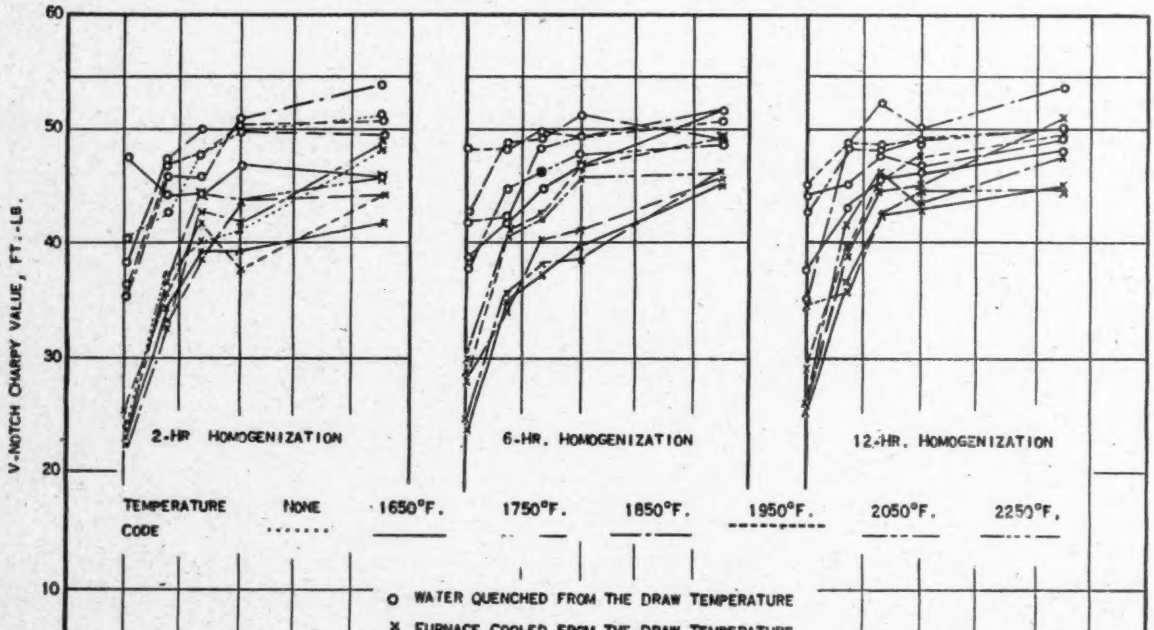


Fig. 12—Plate No. 3—Effect of homogenizing temperature on V-notch Charpy values.

Fig. 13—Plate No. 4—Effect of homogenizing temperature on V-notch Charpy values.



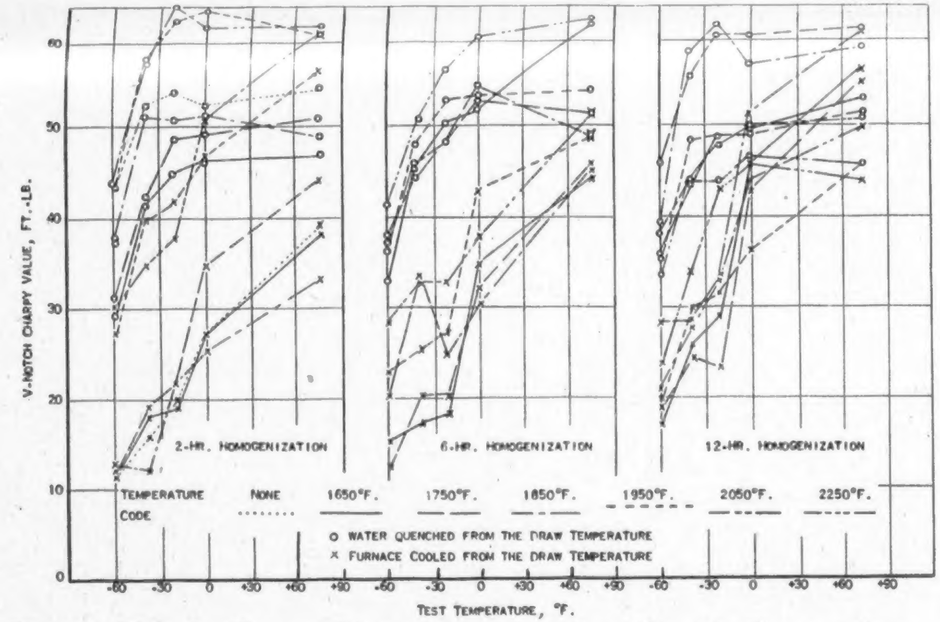


Fig. 14—Plate 5—Homogenizing temperature effect, V-notch Charpy values.

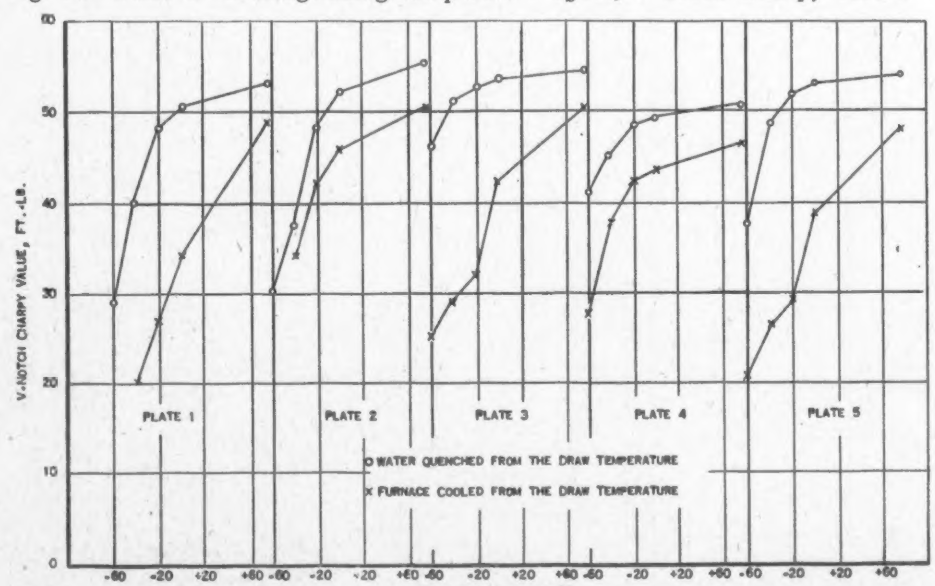


Fig. 16—Effect of testing temperature on the average Charpy values of the five steels. Each point represents the average of all specimens tested at that temperature regardless of prior heat treatment.

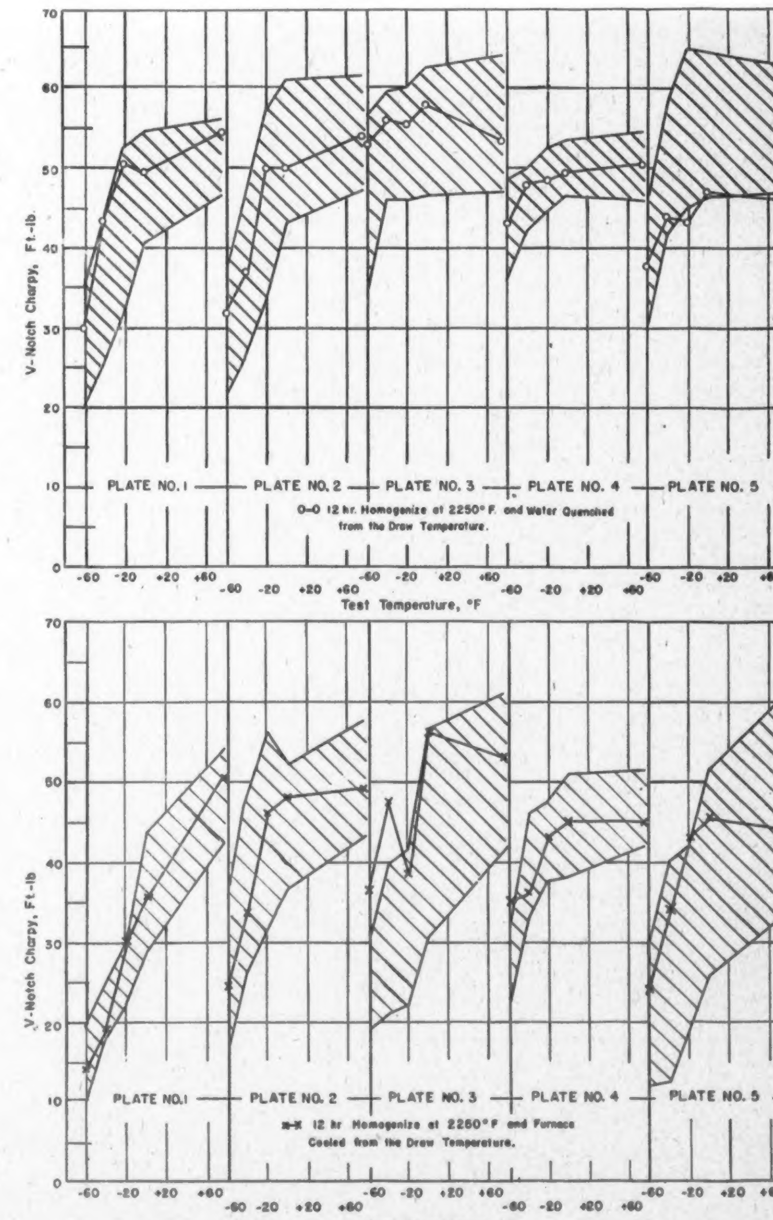


Fig. 15—Range of Charpy values after various homogenizing heat treatments and values after a 12-hr. homogenize at 2250° F.

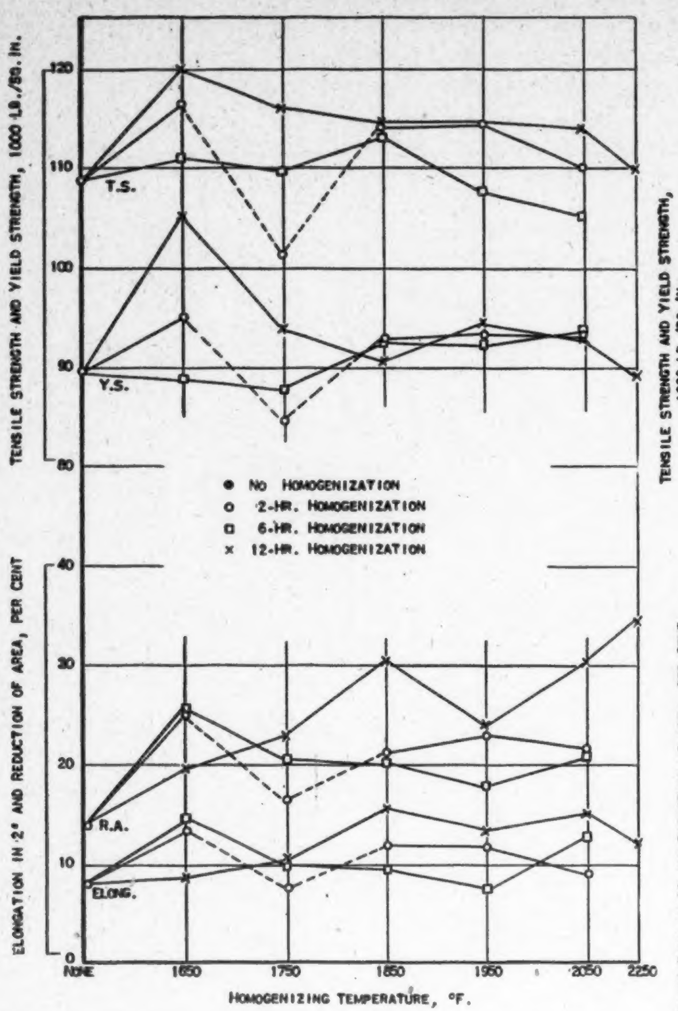


Fig. 17—Plate No. 1—Effect of homogenizing temperature and time on tensile properties. Dotted lines indicate uncertain values because of blow holes in the bar.

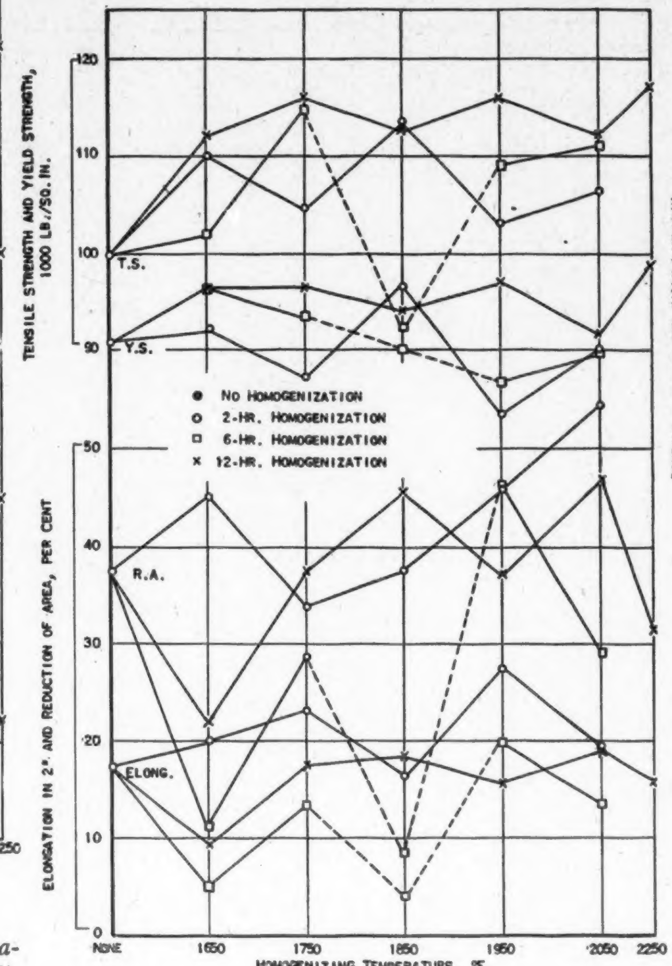


Fig. 18—Plate No. 2—Effect of homogenizing temperature and time on tensile properties. Dotted lines indicate uncertain values because of porosity in the bar.

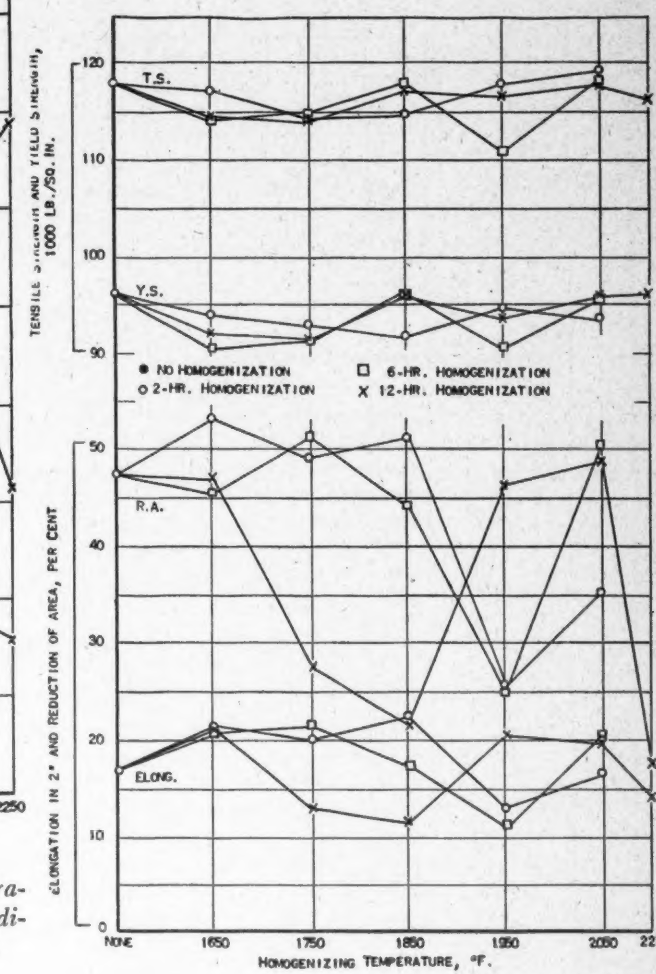


Fig. 19—Plate No. 3—Effect of homogenizing temperature and time on tensile properties.

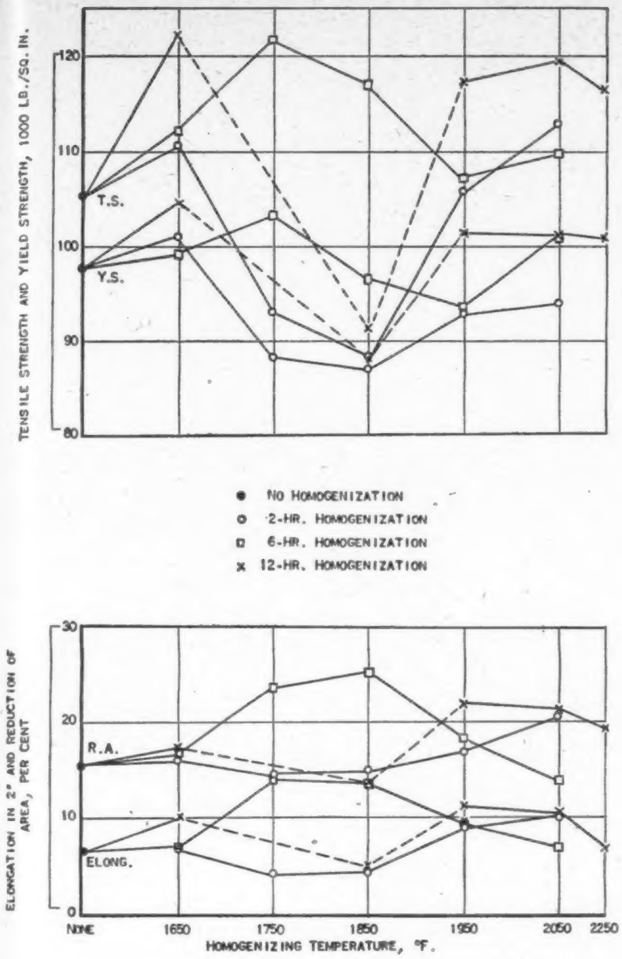


Fig. 20—Plate No. 4—Effect of homogenizing temperature and time on tensile properties. Dotted lines indicate uncertain values because of porosity in bar.

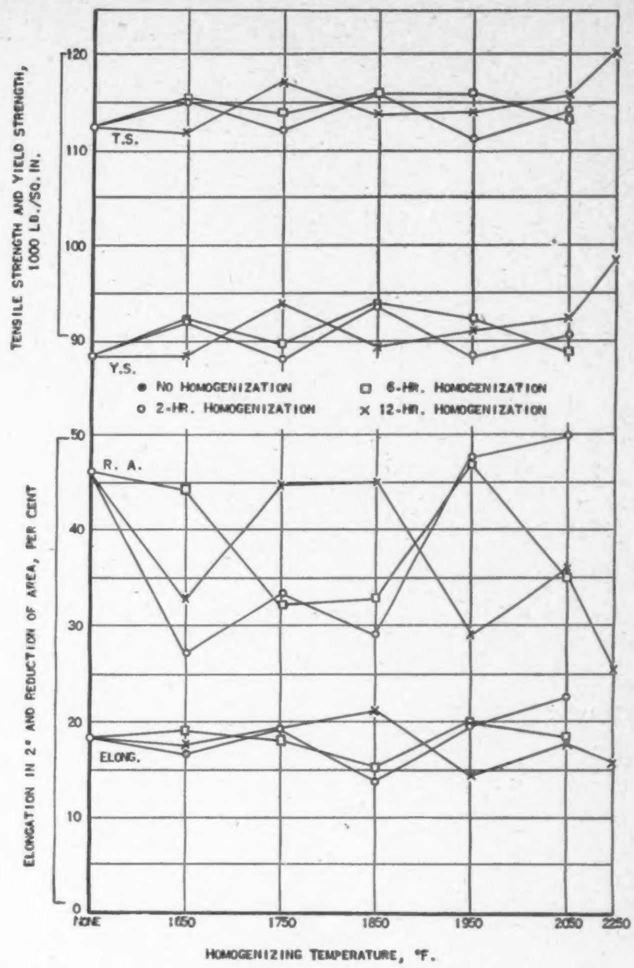


Fig. 21—Plate No. 5—Effect of homogenizing temperature and time on tensile properties.

mens in all cases falls within the range of the homogenized bars, suggesting that homogenizing has not resulted in any improvement in notch toughness.

In general, the same conclusions can be drawn with regard to steels furnace cooled after tempering. For Steels 2 and 4, the longer holding times appear to bring the room-temperature values closer to those for the water-quenched specimens, but the normal scatter in results may make this more a matter of chance than an actuality. It can be concluded that homogenizing heat treatments, in the case of the five steels examined, have not noticeably improved the notch toughness nor reduced the tendency toward temper brittleness.

It would be expected that if homogenization heat treatments affect the notched-bar properties, the most drastic treatment used, i.e., 12 hr. at 2250° F., would show a more obvious trend than the others. Thus, it might be expected that if the 2250° F. treatment improved the notched-bar properties, there would be some evidence of this effect in the data. Figure 15 was constructed to examine this point. The shaded areas in this figure represent the range of values obtained from coupons which had received the various homogenizing heat treatments excepting that at 2250° F.

The curves within these shaded areas give the test results on the bars homogenized 2250° F. for 12 hr. Since these curves generally fall within the shaded areas and are not restricted exclusively to either the top or bottom portions, it can be concluded that the homogenization at 2250° F. has not noticeably affected the notched-bar properties. This holds for both the water-quenched and furnace-cooled portions of the coupons.

Figure 16 represents the temper-brittleness susceptibility more clearly than do the preceding ten curves. In Fig. 16 the points obtained by averaging all of the values for any one testing temperature are plotted. Notable differences in temper-brittleness susceptibility and low-temperature toughness in the five steels are evident in Fig. 16. For instance, Steels 2 and 4 show the least tendency toward temper brittleness, and Steels 3, 4, and 5 have the highest Charpy values at the lower temperatures.

The ability of molybdenum to repress temper brittleness is at least partially indicated by the results of the Charpy tests. The two steels, 2 and 4, having the lowest susceptibility also have the highest molybdenum contents. The other three steels all contain molybdenum and show little sign of loss of toughness from temper brittleness at room temperature, but at lower temperatures the brittleness develops. This information suggests that molybdenum may act merely to shift temper brittleness to lower tempera-

Table 6

AVERAGES OF TRIPLE-NOTCH IZOD TESTS MADE AT ROOM TEMPERATURE

Time at Temperature, hr.	Izod Impact Values, ft.-lb. Plate No. 1	Plate No. 2	Plate No. 3	Plate No. 4	Plate No. 5
HOMOGENIZATION—NONE					
None	49½	57	58½	53	55½
HOMOGENIZATION AT 1650° F.					
2	51	58	58	51	49
6	52	53½	57	48	54
12	46½	54	50	49	52
HOMOGENIZATION AT 1750° F.					
2	52	57½	56½	51	51
6	55	54	56½	50	52½
12	53	55½	59½	—	56
HOMOGENIZATION AT 1850° F.					
2	48½	56	57	—	52
6	51	53	54	52	55
12	52	57	62½	54	60
HOMOGENIZATION AT 1950° F.					
2	49	62	57½	51	58
6	52	57	65	53	57
12	56	55	52	55	49½
HOMOGENIZATION AT 2050° F.					
2	53	56	56½	51	57½
6	53	57	51	53	57
12	51	53	59½	53	49
HOMOGENIZATION AT 2250° F.					
12	55	51	54½	49½	49½

tures rather than entire repression.

Figure 16 shows that the five steels have about the same room-temperature Charpy values. It will be remembered that Plates 1 and 2 were too low in hardenability to harden throughout the cross section. It would be expected that this lower hardenability would result in lowered notch toughness values, since best results with this property are obtained after a full quench and temper. Apparently, the specimens were taken from metal sufficiently close to the surface to avoid the semihardened areas of Plates 1-2.

Room-Temperature Izod Tests. The average of two triple-notch Izod bars for each steel and heat treatment are given in Table 6. Neither a variation in homogenizing time nor temperature has produced any significant change in room-temperature Izod values. The values closely obtained from the V-notch Charpy bars tested at room temperature.

Tensile Properties. The properties determined by the tensile test were quite frequently lowered by porosity or blowholes in the test specimens. This is apparent from the occasionally erratic curves in Fig. 17 to 21 wherein the tensile properties are plotted against homogenizing temperature. It should be recalled that the test coupons were drawn to 240 to 260 Brinell hardness, and presumably the tensile values should be quite similar in all cases.

In several of the figures, it appears that homogenizing has had some effect on the tensile properties, but it is believed that this relationship is merely a coincidence, since a thorough study revealed a closer connection between tensile properties and location of the specimens in the original plate than between tensile properties and homogenizing heat treatment. The variations in soundness throughout the castings, discussed later, certainly were large enough to account for some differences in properties.

The elongation and reduction of area data given in Figs. 17 to 21 bring out the fact that Plates 1 and 4 on the whole are less ductile than the other three plates, with Plate 4 the least ductile of the two. There are two likely causes for the deficiency in the case of Plate 4—its unsoundness, as brought out by deep-etch tests, and its higher carbon content (Table 1).

Less evidence of unsoundness in Plate 1 is shown, but closer examination revealed a finely distributed porosity or unsoundness that is likely the cause for low ductility in this plate, since its carbon content was not excessively high. It will be noted that the room-temperature notched-bar values for Plates 1 and 4 were also slightly, although insignificantly, lower than those of the other three plates.

The inclusion distribution is another factor which controls ductility in cast steels, but it is fairly evident from an examination of the inclusions that they are not involved in the low ductility of Plates 1 and 4. The results of the inclusion study are discussed more fully in a later section.

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5. C. E. Sims and H. Holm, Unpublished data obtained at Battelle Memorial Institute.

(Although contrary to usual AMERICAN FOUNDRYMAN *editorial practice, the length of this paper and number of illustrations made it necessary to run it in two parts. The concluding installment will appear in the December issue.)*

Name Committeemen For Founders' Society

TECHNICAL COMMITTEE of the Gray Iron Founders' Society, Cleveland, will be headed by George Johnstone, Lawrence Foundry Co., Grove City, Pa., as chairman, according to an announcement made recently by headquarters of the Society. Also appointed to the committee are:

H. W. Dietert, Harry W. Dietert Co., Detroit; Dr. R. A. Flinn, American Brake Shoe Co., Mahwah, N. J.; J. D. Judge, Hamilton Foundry & Machine Co., Hamilton, Ohio, and J. S. Vanick, International Nickel Co., New York.

WHAT MANAGEMENT SHOULD KNOW ABOUT TIMESTUDY

Phil Carroll, Jr.
Registered Professional Engineer
Maplewood, N. J.

In any survey of timestudy and wage incentive methods, dozens of differences will be found. Some of these inconsistencies result from unlike concepts. Some are caused by negligence.

Either of two groups is at fault according to which way we look at the cause. Timestudy men may be at fault for not insisting upon being allowed to do their work correctly. Management may be to blame for not hiring the right kind of men. However, fixing the responsibility does not solve the problem.

Whether we have an old incentive plan that has become sadly dilapidated or are about to start a new one, there are certain sound fundamentals which must be understood before we can expect to get the best over-all results. Management should understand these fundamentals because it is responsible for the success of the enterprise. Management should know the difference between right and wrong, whether it is hiring timestudy men for the work or using its own men.

One of the first things to be straightened out is the difference between incentive and base wage. These two have been mixed until many people cannot see a distinction. In part, this results from long use of piecework with monetary rates. Also, it comes from the extensive use of the low base rate-loose standard incentive plans. Both types have given consideration to compensation primarily without regard for work measurement.

Much of the mixed thinking carries over from the past wherein incentives of many types have been "figured out" from past performances. These abortions are at the root of most of the negative reactions to wage incentives. They were the chief reasons why we had "rate cutting." There are other reasons, of course, which in the main have to do with poor timestudy. These will be developed later.

But the point is that there is no uniform measure of work done when the incentive base varies between plants. There is no standard definition of a fair day's work. The yardstick has different lengths and the differences in length greatly exceed the variations between the several patternshop shrink rules. Looked at from one side and assuming comparable base rates, the differences are reflected in unlike earnings, and hence, costs. From the other side, the earned rates may be comparable and the differences in work standards will then be shown as differences in base rates.

Here is where we should begin to take stock. It is apparent that two general trends are working on base wages. One is moving all rates upward. The other is making base rates consistent for a company and even for an industry. Both trends disregard differences in standards established for wage incentives.

Sound incentives result in higher take-home wages, lower costs and increased productions. For as small an investment of time and money, these benefits cannot be obtained by any other means now available. It is good business to give serious attention to sound timestudy-wage incentive administration. Management should endeavor to be as soundly practical in this field as it considers itself to be in other parts of business administration. In so doing, it will directly improve its employee standard of living and better the operations of the business as a whole.

Revising Standards

When previously set incentive standards have been made loose to compensate for low base rates, these two trends wipe out some portion of the wage differential. Then, unless the standards have been revised accordingly, the cost includes two payments for the same thing. It includes the cost of the raise and the cost of the extra time in the standard which was allowed previously to offset the low base rate. The extra time is equivalent to an increase in base rate and applies as a percentage multiplier to every increase added to the hourly rate.

So it happens that those plants which set loose standards to make

Presented at a Job Evaluation and Timestudy Session of the Fiftieth Annual Meeting, American Foundrymen's Association, at Cleveland, May 9, 1946.

up for low base rates will have excessive costs because the wage scale is moving up independently of the time allowances. The higher the wage rates go, the greater will be the distortion.

Normal Output. Many reasons make it obvious that there is little likelihood of base rates being the same universally for the same job. However, there seems to be plenty of evidence pointing toward a growing similarity, as time goes on. Therefore, it appears increasingly important to get uniformity in the task level or work measurement standard. Without uniformity in the measure of a day's work, the correction of inequalities in wage rates will magnify those inequalities and throw them over into greater differences in "take home."

The solution to the problem lies in a common understanding of a normal operator performance. Normal is not average. Average is highly variable and changing. Average is a term which should be crossed out of the timestudy language and particularly omitted from contract clauses purporting to define the basis for wage incentives.

True Measurement

It is necessary to have a "yardstick" which is constant—a measure which does not change from one department or plant to the next. The yardstick should be the same in good times and poor. The reason is that there is but one fair time to perform an operation under a specific set of working conditions.

This can be attained only by having a bench mark or common base of reference. Such it is hoped will result from the work of the National Rating Committee of the Society for the Advancement of Management. It is planned to produce motion-picture films of typical operations at known rates of operator performances. These will be standards because they can be shown at identical projector speeds anywhere in the country, thus establishing a common basis for measuring work performance.

The Big Variable. To some managements and timestudy men effort rating means nothing because they do not know that fair standards cannot be set unless the performances observed are rated in terms of a "normal." They still think in terms of average times, which are unfair and inconsistent. Averages of poor performances produce loose standards. Averages of best operator times result in tight standards, and it is foolish to think that one can select a normal performance without being skilled in effort rating.

Rating

Rating is the appraisal of the actual pace at which the work is being done. Rating is vital to currect timestudies because the actual pace may be anything from 50 per cent to 200 per cent of the normal sought. It goes without saying that herein lies the largest variable in the whole timestudy procedure.

Consequently, there are two benefits to be derived from film standards of known performances. Most important, they can provide the basis for establishing a uniformity in task level so that with like base rates and like performances the "take home" will be practically the same.

Timestudy men can use such films as gauges to measure their ratings. Standardized films can be made to provide training for timestudy men and others in correctly judging the actual performances being studied. Thus work measurement and incentives could be brought to the same standard of expectancy and, as the author sees it, into the same range of uniformity as base wages for like work are approaching.

Beware of Simplification. With the same concept of normal performance, there is another type of mixture which distorts earnings. This is one for which management and accountants are largely to blame. Their thinking is in the right direction. Sometimes, it is in an attempt to meet a laudable need. However, often it is urged upon timestudy men in a mistaken desire to save overhead. The importance of simplifying the incentive plan, without fully recognizing the costs of simplification, is overstressed.

Delays

One of the most important fundamentals to be understood is that fair incentive plans cannot be simple. To be fair, allowance must be made for delays beyond the control of the operator. Delays should not be included in the standards because variations in the actual delays from the averages which might be allowed will directly affect operator earnings.

Separate allowances must also be made for differences between the actual and normal working conditions. Otherwise, the differences will affect take-home pay. Variations in the amount of work to be done and delay time which interferes with production are two complexities which cannot be averaged into the standards if the incentive plan is to be fair. Therefore, it should again be emphasized that incentive plans cannot be simple and, at the same time, be fair.

Piecework is a type of oversimplified incentive plan that is often mentioned as highly desirable because it is so easily understood. Of course, so much a piece is easy to explain because the transaction is exactly like that carried on in ordinary shopping. But so many dollars and cents per piece cannot be fair because it takes in a lot of averages which sometimes work in favor of the operator and at other times have the opposite effect.

Piecework

Then, too, piecework is always being subjected to compromises of many sorts, which means that it soon loses its relation to work done. Besides, every time there is a change in wage rates the piecework prices must be recalculated or adjusted by compound percentages. This latter "simplification" certainly contradicts the initial premise.

Another simplification which resembles piece rates is that worked out in terms of pounds or tons. In foundries and steel mills the basis called "tonnage rates" is often used. These simplified "rates" usually include gross inequities because they are based on averages.

Such simplified incentive applications have the obvious advantage of somewhat easier explanation and computation. But, in addition to being unfair, there are other factors to remember. In the first place, the ease of explanation at the time of introduction will soon be overshadowed by a perpetual stream of explanations of those conditions which adversely affect earnings. In many cases, additional allowances will be made. As a result, the worse-than-average conditions will be paid

for twice. Thus endeth the first lesson—do not use averages.

Oversimplification of an incentive plan may save some clerical costs, to be sure, but that is being penny-wise and pound-foolish. Simplification is effected by using averages for varying conditions and delay times. Averaging these expenses and including them in the standards may save the clerical cost of computation and distribution, but would hide wastes which, if known, would certainly be reduced and salable production substituted. Good, salable pieces can absorb not only the costly items of overhead but also the relatively insignificant cost of a few extra clerks.

Costs of the wastes continue until eliminated, no matter how they are concealed. A sound fundamental of good management requires first of all that the time facts be revealed. This will require more in clerical effort, but the additional cost can be offset by reducing production interferences.

Extra Items

Extra time or work must be paid for if the incentive plan is to be fair. These extra items should be at a minimum when management control is really effective. Under such conditions, there should be no reason for paying "average incentive earnings" for day-work time. However, if management gives way to pressure for this "fringe issue," it should be correctly analyzed as such and tacked onto the base rate.

"Can't Be Done." Suggested by what has gone before is another dreadful pitfall into which many managements tumble. There is no excuse for falling because it can be seen far in advance. It is fundamental that it is not the amount of earnings which cause the troubles, but the differences. It also is true that if incentive is good for some, it is good for all. It is known in advance, then, that incentive must be provided throughout the shop if in one department.

"It can't be done," say many otherwise capable executives. Some have been heard to insist that incentives could not be applied in their businesses, even when they knew of successful application in almost identical shops.

"It can't be done" is not the answer to the highly skilled man on day work who earns less than lower-rated operators on incentive. "It can't be done" is not the answer to the large proportions of indirect people in many plants where incentives have closed up the wage differentials. "It can't be done" will not satisfy the foremen who take home less than the people on incentives whom they supervise.

Incentive Opportunities

It can and must be done in order to provide incentive opportunities for all. And these should not be the "figured out" kind which arbitrarily pass on to the day workers some percentage increase calculated from the earnings of those on incentive. That too is an oversimplified method of granting what amounts simply to a pay increase.

It is easy to fall into these procedures. But they are treacherous. To begin with, there is no assurance of an increase in output commensurate with the greater pay. As a rule, there is not a direct relation between the efforts of indirect and direct workers. In general, the proper ratio of indirect to direct is a changing one, being high at low volumes and low at high volumes.

In the second place, and this is more important, such schemes do not have any record of the work content of the jobs involved. Consequently, there is no logical means for adjusting the incentive payments as the ever-changing methods make it necessary to alter the number of people assigned to the work.

Consequently, either unjustified accusations of "speed up" are aroused, or what is worse, payments of unearned premiums are continued. The author feels that this latter is the more detrimental because the unfairness grows with improvements to the point where the producers complain about having to work to earn their premiums while others can get as much by loafing. When this stage is reached, the whole setup is in jeopardy.

Poor Timestudy Men

It Costs Too Much. Many of these problems apparently cannot be solved because the timestudy men do not know how to measure work which is not routine. Here is another fundamental which management cannot afford to side-step. Management must recognize that poor timestudy men are the most expensive in the long run.

Skilled timestudy men are required to measure nonrepetitive operations. They must know how to make the maximum use of timestudies by the standard data method. This is where the difference lies. Of course, "it can't be done" by the ordinary "rate-setting" methods of direct timestudy. Not only does it cost too much, but direct timestudy cannot provide incentive until after the nonrepetitive job is completed.

If timestudy men cling to the traditions of continuous watch readings, average times, and perfecting the methods before setting the standards, they never will get around to complete coverage by incentives. The answer is to get men big enough to do the job of measuring out-of-the-ordinary types of work.

Bigger men will help in other ways. For example, the right type will not "go along" with some of the crimes perpetrated in the name of incentive. They will prefer to work in other plants. They will have more of a professional attitude toward their work and refuse to do things which may be expedient but incorrect.

Human Relations

Men who can do a good job and stick by their guns will not only solve many of the so-called problems of incentive but will be acceptable for promotion into executive positions. They will be broad enough to understand that sound timestudy work is largely human relations, not stop-watch engineering.

Standards Must Be Changed. Timestudy men who can do a good job will insist also that standards must be kept in line with work done. They cannot be induced to put off the revision of a standard after the method has been changed. They know that the longer it is postponed, the more difficult will be the justification when revised.

There is no escape from the ever present problem of maintaining fair standards. Failures in and of themselves usually do not cause as much trouble as the patchwork remedies applied in other directions in attempting to offset the odious con-

ditions created by the failures to correct for changed conditions. Two wrongs never made one right.

Incorrect and incomplete maintenance soon allows a soundly established incentive plan to become as inconsistent as one set up by poor timestudy. The earnings become irregular and inconsistent. Restriction of production usually sets in. Grievances pile up. Compromises bring on precedents and the spiral is started. When management thinks this has gone too far it may try to stem the tide by saying "No!" Then the cases go to arbitration.

Do Not Arbitrate Standards. Here a shortsighted management may think that arbitration is an appropriate way to solve the problem. Such is not true for several reasons. Arbitration usually ends in a compromise. But that is not measurement. Splitting the difference is not the way to determine incentive standards. Some part of the error continues. The real solution to the problem starts way back at the time methods were changed, when the standard should have been revised in strict conformity.

Correct Procedure

However, having thought that time would effect a cure and eventually having reached an impasse, the proper solution is not arbitration. The only correct procedure is to select a thoroughly competent timestudy man and engage him to determine what the standard should be. In this way the principle that standards should measure the work content of the job is not violated. Also, inconsistencies which "are binding on both parties" are not created.

Explaining Timestudy. There are many other things which management should know about timestudy. Many of these are properly cared for when management picks out high-grade men for timestudy work —those who have a professional attitude toward their jobs. For example, the problems which arise because the organization has not been instructed in the methods of timestudy are recognized and met.

Good timestudy men would not make the mistake of neglecting to inform the supervisors and union stewards. They would know that the industrial relations problems brought on by timestudy and wage incentives can best be overcome by anticipating them with ample explanations. The explanations should not be technical. The shop folks are not interested in techniques. They are more confusing than helpful.

Nevertheless, all questions must be answered satisfactorily. To do this requires that definite policies be established. The rules must be set down. If they are not definite, the explanations will be weak, of necessity, and the "cover up" will be suspected. Then there can be no confidence that the future will be different from the past. Confidence is an essential part of successful incentives. It must be thoroughly established and scrupulously maintained.

As a part of the program of instruction, two parts seem important enough to stress. First, precautions should be taken to see that new people are given the same benefits of understanding that were developed initially. If this is not done, then turnover will dilute the understanding to a point where anything can happen. An ounce of prevention should be given in the way of specific explanations at the time the new employee is inducted. A printed explanation included in the employee's handbook will be helpful.

In addition, the foreman should be obligated as a specific part of his responsibilities to again go over the full explanation of the incentive plan. This will improve the understanding by repetition, even if no other gain is made. But organizationally, it is necessary that the foreman make certain that there are no misunderstandings. This vital step in sound administration is completely overlooked in some organizations, and poorly done in many.

Incentive Plans Not Known

One of the reasons for this is that management has not realized how necessary it is and, therefore, has not made it a requirement. It has been side-stepped because foremen, in general, do not know enough about their incentive plans to make an understandable explanation. This a sorry condition and, until it is corrected, avoidance of industrial relations problems can hardly be expected.

As a stopgap, every foreman should be given extensive training courses in timestudy. And some day, if it is seriously desired to make incentive plans operate smoothly, promotions to foremanships will go only to those capable leaders who have successfully served an apprenticeship in timestudy work.

Why Bother. All of the foregoing makes a big job and requires a lot of hard work. Sound timestudy-wage incentives are no different from anything else worth while. And, experience has shown that there are many elements of business administration on which management spends more time and money without nearly as profitable a return.

DISCUSSION

Chairman: R. J. Fisher, Falk Corp., Milwaukee.

Co-Chairman: F. E. Wartgow, American Foundrymen's Association, Chicago.

W. E. George[1]: Mr. Carroll spoke of the existence of only one fair time standard. That time will vary with the incentive opportunity, will it not?

Mr. Carroll: That is correct, but the opportunity, as I tried to indicate in the beginning, seems to have been worked backwards in trying to adjust for a difference in a wage level, from what might ultimately be a more uniform wage level. In other words, there have been a number of plans established where, for example, the man was paid 40 cents an hour and was expected to make 40 cents more, because we wanted him to have an 80-cent take-home to be comparable with similar jobs in the area.

If now we pay him 80 cents for the same job, because they pay 90 cents across the street, then the level for the incentive must be made consistent with it.

Mr. George: The standard in that case would give you $1.80 if you raise the rate to 90 cents. I am speaking of the fact that you can put in the incentive plan to pay off 20 per cent for normal maximum output or you can put it in to pay 30 or 35 per cent.

In terms of Society for the Advancement of Management studies, will the pace you picture represent a pace that is one for the below normal or above normal?

Mr. Carroll: It will be a statistical summary of opinions throughout the country. I have suggested that such will be a 45-unit hour. I do not know what the answer will be. Irrespective of the level established from this, it would still be possible to set up a plan so that you would pay 20 or 30 or 70 per cent over.

Mr. George: I believe that it is easier to establish the top than it is to get it to 45 or 50 or 60 per cent, where you want it.

Mr. Carroll: Yes, and I will agree with you that the top is established by the customer, and if we work back from that, we have got the top on the one hand. If your union establishes the bottom, on the other hand, I would like to suggest that there is a uniformity re-

[1]Booz, Allen & Hamilton, Chicago.

quired, which may be in the nature of 25 per cent premium.

Mr. George: I agree with the 25 per cent, we will say for the moment, but that will be a 64-unit hour, if you expected the employee to earn 80, rather than a 60-unit hour to pay base rate. In other words, in one plant the standard would be 60 units, in the other plant 64 units, if your normal top expectancy is an 80-unit hour.

Mr. Carroll: I do not think there is a top expectancy in a well-operated plan.

Mr. George: I use the words "normal top" figuring there are always some who will exceed any standard.

Mr. Carroll: Yes, but I was endeavoring in this group to close some of the gaps between a 30-unit hour and a 60-unit hour, more than I was between an 80 or a 75-unit hour earning expectancy.

J. A. Westover[2]: I am wondering if it would not be well to say something about expressing standards, either in money or in time. Too many timestudy men have the problem of trying to convince management that they should express their standards in time, and management seems to want to keep it simple, as they term it, by expressing it in money.

Mr. Carroll: You can not allocate overhead on a wage dollar basis and get the right answer. You can not plan production on a piece-work base and get anything that will work. If you attempt it, you must also operate a time basis, and for that reason, and in view of the ever-present tendency to change wage rates every time you rewrite a contract, I am not in favor of piece-work. The reasons for that are several.

First, we immediately mix compensation and measurement, and the timestudy man cannot solve the problems which result. In a great many situations he has no voice whatever in wage rate, because that was negotiated in the contract, and because the intent is the same on the worker's part as it is on yours and mine, to try to get all he can for as little as possible. He puts the pressure on the piece-work price, so we compromise it here and there, to satisfy the complaint.

Next year when we negotiate another contract we re-figure all of the piece-work prices or add on another one of these accounting simplifications, in which we figure from the old base, four changes back with compound percentages, and then wonder why the shop man cannot understand.

But my reasons are much more fundamental than that. Wage incentive, as I see it, is only a means to an end. The only purpose of wage incentive is adequately to reward the man for what he does and to sustain his interests in going along at a pace of operation that you can depend on when you make a quotation.

When you have time standards, wage rates which have been established by the contract, and you know what this group or department has averaged for the last six months, you can predict what the production cost will be almost within nickels.

Chairman Fisher: You spoke about placing incentive on indirect labor. Could you give us any concrete examples, for instance, how to set incentive on crane operators? On what basis would you establish it?

Mr. Carroll: In many foundry operations the crane man has considerable control over amounts of delay time, and that would be one of the substantial factors that I would consider in placing him on an incentive basis. Under a well established incentive plan, we have a measure of how much delay time there is, and if by a little more diligence on his part he can reduce that a certain per cent, I would be one of the first ones to be willing to reward him for it.

Now, to answer Mr. Fisher's question in a more general way, the way I would approach a question such as that is: What is it we are trying to accomplish? If, for example, in a steel foundry, where the man is using acetylene to burn off the gates, risers, and heads, we wanted to make some cost reductions of value there, I would not forget the fact that the acetylene is worth more than the man. So an incentive plan that would be based on that kind of casting cleaning should have some substantial portion based on the cost of acetylene and some portion based on the man's diligence.

Member: Have you any suggestions on setting the standards on something such as contributory labor, melting department or cupola furnace?

Mr. Carroll: Most everything we find has a time measurement, irrespective of the plan which might be worked out. Take, for example, this crane operator question. I would start with timestudy, and you would say, "Well, this man does 10,000 jobs. Why start with timestudy?" Suppose at the start we decide that there should be four crane men per 100 operators, or what have you, and later we make a change.

Are we not going to be faced with accusations, false though they may be, of rate cutting because later we decide it should be three men, or we change some people in the productive department, which means three crane operators can handle it? When we have no record as to what was in the allowance for four men initially, we have no logical means of changing to something else.

So I would start with the timestudy in every case, and in anything as relatively simply as electric furnace operation, it is almost as clean-cut as the center floor molding.

Member: You mentioned that when an improvement is made on a job or an improvement in the method for doing the job, then the standards should be changed simultaneously. What method should be used to remunerate the employee who suggests that improvement?

Mr. Carroll: I think the remuneration should be through a well-established suggestion plan, and do not assume the operator did not go beyond the second grade and try to get him to trade 100 cents on the dollar for 10 cents.

I do not know what amount it should be, but the most successful plan I know anything about is the Lincoln Electric plan in Cleveland, which has operated successfully with a 50 per cent basis. Whether it should be 50 per cent for one year, 100 per cent for six months, or some other percentage, I do not know.

I think that the suggestion plan, well operated, means adequate reward, adequate publicity, and putting the thing into effect, because the thing that the man is interested in, in the first place, is to see his own handi-work in operation, so that he can point to it with pride.

So there are three phases to successful suggestion operation, as I see it, but in total, I do not think it will solve more than 30 per cent of the problem. You still have a couple of hundred years of incentive background, in which many of us still think that it is the man's invention and the way to pay him is to let him keep on profiting from the old standards. We have got to live that down first, and I think it has to be a good offensive in the way of a well-operated suggestion plan, not one in which a committee of brass hats sits around and decides whether it ought to be $3 or $10.

No, it ought to be the difference in the standards, carried out in so many dollars, or based on, as you may choose, a year's activity, or if you wish to raise the percent of the award, a six months' activity. Some folks have gone so far as to base it on the previous activity instead of the forthcoming activity, in order to cut it off and have it a clean-cut calculation.

Mr. George: Would you pay less than the average earnings? Let us take a dollar-an-hour-man, earning $1.30, and he is put on work that essentially cannot be standardized. We are putting a new model into production, building up from 10 pieces a day to 500 over three weeks. This is not exactly a trial period; it is getting the equipment ready, getting the job into high production.

Mr. Carroll: In order to answer your question, I will go along with your assumption that you cannot put it on standard, but I do not agree. Let us take that assumption.

Mr. George: You might have two or three temporary standards at different stages in the three weeks. Would you advocate using temporary standards?

Mr. Carroll: Not temporary standards, because temporary has a strange way of becoming permanent, especially if the contract reads that at the end of 90 days a temporary standard shall become permanent. I would not use a temporary standard under any circumstance. It has had a distasteful flavor for a great many years, because we in timestudy and management use the word "temporary" so we can keep a string on the standard and pull it back if we do not like the outcome.

I would set what I would call a plus standard. If you have standard data and a well-equipped timestudy department, especially if you purchased equipment on the basis that it was going to save you so much money which had been pre-

[2]Westover Engineers, Milwaukee, Wis.

determined, then I would compensate the man with an extra time allowance, the same as if the casting got hard or the sand got wet or any other extraneous condition spoiled the casting.

The expense part of the standard would always remain separate from the basic standard. However, assuming that you cannot put the man on standard, as you state is the case, I urge the use in that and similar cases of a carefully thought out, proper job evaluation base rate, for that kind of skill.

MR. GEORGE: Suppose you had a properly thought out base rate in the example of a dollar an hour.

MR. CARROLL: But you would not have it for that kind of experimental work.

MR. GEORGE: Essentially it is not experimental work. It is carrying the job on. You are changing the job every day, improving the equipment, getting new fixtures in the production line. I agree with you, if the standard were the plus value, but many companies do not do that. They figure, "We are going to run anywhere from 100 to 500 and up it more and more each day until we get up to 500." In that period, to me the dollar is the valuated base rate. The man has been earning $1.30. If you call it an experimental period and choose to give him an evaluation of 115 per cent of base, you might do that. I wondered if you advocated that.

MR. CARROLL: I advocate that because I am deeply set against paying the average earned rate.

MR. GEORGE: So am I, but I wondered if you would rather see it go back to the dollar or go back to what we will call an experimental value stated in the contract, 110 or 115 per cent of normal valuation.

MR. CARROLL: A fixed amount is more fair because if you and I are working together on such a job and, because of your skill or energy you make $1.35 and I have been working at only $1.25, to guarantee each of us our past earned rate does not solve the problem. One of the difficulties arises because usually we pick the better earners to carry on this kind of work.

MR. GEORGE: I tried to avoid that by giving you just the production line changing from the 1946 model to 1947. We merely picked the old line and 17 workers on the line, so we did not deliberately pick the best people.

MR. CARROLL: To pay past earnings is another illustration of my initial premise that we are mixing together compensation and measurement. There is no relationship whatever between the output that is turned out during that period and any guarantee you might make. So why do we not call it day rate, and why do we not pay a rate for the job which is acceptable, or which, if it happens to involve an extra skill, as sometimes it does, the employee might have been earning $1.30 but this job might be worth $1.50, pay him $1.50.

MR. GEORGE: Essentially I am talking about the dollar job, and I am questioning whether he deserves more than the dollar when you have to take him off $1.30 incentive work temporarily and run it as a day-work job, maybe two days or ten days.

MR. CARROLL: The answer is, "No," because you have kept insisting that there is no extra skill involved. We know in advance he has given us 50 per cent performance or a 30-unit hour on day work, so there is no deserving of any more than $1. That is not the question.

MR. GEORGE: That is the question because many companies figure the man deserves to make more merely because he has been earning more. They lose sight of the value of the job, and see what the man has had as an income.

MR. CARROLL: That is right. That is only an easy remedy for what they term to be a difficult situation. It is a way of avoiding grievances.

C. S. HUMPHREY[3]: From your remarks, it occurred to me that there was a greater difference between a wage incentive plan and piece work than I had realized, possibly more than some of the other men have realized. I wonder if you would elaborate on the difference?

MR. CARROLL: Do not misunderstand me. Both of them are incentive plans, and there are a lot of incentive plans that are expressed neither in time nor money. An incentive plan is anything which is brought into effect which will induce the employee to do something he did not do before or would not do otherwise.

This suggestion award method is an incentive plan. That happens to be financial, but this idea of training programs, so that people can move up in the organization, is one of the primary desires. Most of us think wages are the primary desire, but all of your best industrial psychologists will tell you that wages come way down on the list. The desire to get ahead, the opportunities offered for advancement, training programs, and all that kind of thing are incentive plans called non-financial.

The only difference between the two plans that you asked about is that in one of them the standard is expressed in time, and in the other it is expressed in dollars and cents.

Unfortunately, prior to Taylor's time and in roughly 30 per cent of the country today, we still continue the piece-work plan where we offer to pay 15 cents a dozen or $3.50 a ton for turning out so much production.

Essentially that was time, in the first instance, because they decided that the employee could do so many units an hour, and then wanted him to earn 80 cents, so they figure backwards, and that is the way they get the piece-work price.

There is a lot of good piece-work that was established from timestudy, and the quarrel that I have is not with piece-work as such, but that we have gotten away from expressing our standards in time, which will be universal. There are still 60 minutes in the hour so that time is not affected by economic conditions. All of industry operates on a time basis, not a money basis.

[3] C. S. Humphrey Co., Moline, Ill.

The instant the customer agrees to give us the order, in the shop we are working on a time basis. So I have reduced consideration of overhead to the simple explanation that overhead is a rental charge which the customer pays for using our facilities for a certain length of time. All of industry is geared to do a lot in the way of controls that cannot be worked out with money as a base.

Suppose, for example, the molders get $1.25, and the workers at the shakeout get 80 cents per hour, and both rates have been used to set up piece-work prices. Production cannot be planned because there are two different sets of figures mixed. You would have to use a conversion factor, which is the conversion equivalent of using a time factor.

So that wage incentive, as I see it, is a way of continuing to get the man's interest in turning out a certain number of pieces with regularity. It seems to me much more convenient to pay on a time basis as we keep shifting contract wages around, and if we use time, then we can have business controls of one kind or another without going through all of the problems of changing over into money.

We can allocate overhead correctly, and we can plan production correctly. We can predict a lot of things in the line of improvements which bring men to a conference like this, where they can see all of the better ways of doing things. Then it is a question of whether or not we get our money back. All of those things are much more easily done with time as a basic measure.

MEMBER: In the jobbing type of operation, is it practical to write operation sheets to keep standards up-to-date?

MR. CARROLL: In my opinion, no. Operation sheets are a very decided advantage, and they partially answer the question with regard to how you know whether or not there has been a change in the method.

For example, if a foreman were alert and understood the timestudy business, he would know that you cannot expect an operator to make the anticipated take-home unless at least he starts with the methods on which the standard was set. So if he had an instruction card he would know that much to start with. But you run into the law of diminishing returns, where the advantages may not outweigh the disadvantages of the costs of instruction cards.

In the jobbing foundries where you make two of this and six of that, and may never make them again, I would suggest that you might find some simplification, but by and large you could not have what I understand instruction card to be because you could not afford it.

MEMBER: I did not quite understand your answer to the question on experimental jobs. If you have an experimental job, I feel you cannot accurately determine the number of expense units to be added to that job, and you further feel that that job in order for it to be done properly would be necessarily given

to one of your more experienced men. That man is used to earning, let us say 72 or 78 units, however, and you know he is a conscientious worker, and you get good supervision.

I am interested in knowing for control sheet purposes whether you would enter that as day work, where you convert your unit hour to 40, or break him off at 60 or 72 or 78, the unit hour he is accustomed to.

Mr. Carroll: I would break it off at 30. Maybe it should be 15, because if we do not know how many expense units there are in the total, I would certainly be on the conservative side, because if you carried your control sheet over into perpetual inventories and other things, I would rather anticipate the shrinkage than try to write it off later.

Member: That is accurate for control, in other words.

Mr. Carroll: I wish you would not use the word "accurate." There is no such thing as an accurate standard, as you know.

Member: How are you going to remunerate the man? How would he be paid? Suppose he just refuses to do the job if he does not get his double rate?

Mr. Carroll: Of course, that is where I suggested you might have a standardized specially prepared evaluation rate, for that and many other things like it, if you admit you cannot set standards on it.

I will give you a case in point. A plant introduced a new model and they were in a tremendous hurry to get it on the market because their competitor was introducing something new and was going to get it on the market first.

In order to prepare the operation sheets, preliminary to setting standards from data, they borrowed some highly skilled tool makers who had been earning some substantial premiums, to write those operations sheets.

They borrowed them partially because they needed an extra force, but primarily because they had the skill to write the methods. The question arose, How would you compensate those men? They had been making, shall we say, $1.25 base rate and 35 or 40 cents more premium.

The question was answered in terms of a specially prepared job evaluation rate, and the management said, "But you cannot do that. That is more than we pay the timestudy men."

My answer was, "But the timestudy men cannot do it."

It is not, as I am trying to answer your question, related to what the man has been making at all. It might be 10 cents an hour more or 20 cents less. It is what you would set up as a proper job evaluation rate for the kind of skill that you are asking that individual to display, fully recognizing that he is probably going to be, no matter how conscientious, operating at a day-work speed. The day-work speed is not his fault. Almost first, last and always, it is management's fault that he operates at the 30 rate hour, because we do not get the material to him.

Member: Does a money standard give you more productivity than a unit or time standard?

Mr. Carroll: I do not think that question can be answered. If the two standards represent the same value and if the operators understood the incentive plan with its complications, as I explained it, I do not think there would be any difference. I can answer your question the other way, but you might not care for the answer.

If we were introducing an incentive plan to replace the piece-work plan, I think I could assure you of at least 30 per cent increase in production, my reason being that you would not be introducing a new plan if you were satisfied with the old.

Member: What would you guarantee for an incentive plan over a day-rate plan?

Mr. Carroll: In production or cost?

Member: Production.

Mr. Carroll: Fifty to 150 per cent. But management has to do the work. It is not the man in the shop that refuses to turn out more than 30 units an hour. It is because we do not get the material to him and get it to him in such shape that he can work on it.

You can take timestudy into a day-work shop and get a 75-unit hour, which is 150 per cent over a 30-unit hour, but only by segregating management's errors and getting management to reduce them. You cannot eliminate them, but you can reduce them. I say you cannot; you can, but you should not because it will cost more to eliminate them than you would save by so doing, but you can reduce them.

You can do a better job of planning. You can make the stuff come more nearly right. You can have the flasks so they fit and have them delivered. You can do all those things to enable the producer to keep on working. Most of those folks are just as anxious to do a good job as we are, and they do not do any more than they do, because we will not let them.

Frank Wartgow: A small packing plant was working strictly day work, and had always done so. They were faced with the possibility of cutting back from 48 to 42 hr. a week. Management did not desire to cut wages.

They called in consulting industrial engineers. The requirements that they set up were these: They did not care how much their employees earned over and above, but they wanted to be sure that they would not earn less for 42 hr. than they did for 48 hr.

After the survey we estimated the efficiency of the group was 35 per cent. Our superior was reluctant to submit that figure to the packing plant management, so we increased it to 45 per cent, knowing we were on the safe side according to management's specifications.

On my last visit to this plant prior to joining the A.F.A. staff, the operations were earning a 25 per cent bonus. They had increased their output 257 per cent.

Member: Is there a difference between wage rate and compensation?

Mr. Carroll: I think of compensation in terms of take-home. I think of wage rate in terms of the base pay, the hourly guaranteed rate, many of which are negotiated or worked out through wage surveys or what not.

The wage rate is what the man should get for every hour he is present. I think he should get that regardless of the job we put him on. If he is a 90-cent man and we put him on a 60-cent job, I personally think we should keep on paying him 90 cents, because we agreed to utilize his skills at a certain rate, and it is our fault if we do not keep him working on jobs for which he is skilled. He gets that as his assured rate for every hour present, excluding transfers.

The base pay plan is supplemented by adding the incentive earnings, and the total is what I term compensation.

Mr. Carroll *(author's closure)*: Concluding, may I suggest that we keep four things in mind.

1. Incentive standards should be built from standard time data to gain consistency of opportunity, fairness in revision, and maximum coverage.
2. Standards should be revised simultaneously with method change to avoid the difficulties involved with trying later to eliminate the excessive unearned premiums.
3. Incentive plans should be revised to eliminate from the standard times all allowances which may have been made to offset base rates that were lower than going rates.
4. Incentive plans should be extended to measure work before compromise brings on the payment of incentive monies for non-incentive performance.

Stress Analysis Group Will Meet at New York

Annual Meeting of the Society for Experimental Stress Analysis, Cambridge, Mass., will be held at the Hotel New Yorker, New York, December 9-11, and will include a symposium on telemetering of aircraft flight observations.

Inquiries should be directed to the Society for Experimental Stress Analysis, P. O. Box 168, Cambridge 39, Mass.

CORES FOR AUTOMOTIVE MALLEABLE CASTINGS

Sound castings through good core practice . . . a knowledge of the components of core ingredients, proper proportions, mixing and baking are important operational factors.

W. G. Ferrell
Superintendent of Foundries
Auto Specialties Mfg. Co.
St. Joseph, Mich.

An exact knowledge of the core sand components is important if good cores are to be obtained. A check should be made for clay content, and then for materials that will burn at contact with the molten metal. A determination of the size and shape of the sand grains will give an indication of the amount of oil to use, and also how the core will break down during solidification of the metal. Cores will burn out more freely when made with sand having a rounded grain.

Core Oils. The use of a good core oil is important, for it is generally known that a multitude of materials can be added to the oil, which have no basic value in the making of cores. Therefore, unless the purchaser has the necessary equipment for checking core oil, he must know the content of the oil. Chemical analysis of core oils will not indicate the quality of the cores or castings. The checking of core oil is a study in itself, and is most important to all foundries.

Core Oil Composition

However, to the average foundryman, the pertinent facts are: Is the oil right? Will it make good cores? Will it make good castings today, tomorrow and next week at the lowest possible cost? Although core oil is a widely used material, the actual makeup of its component parts is not generally known to the user. The author knows of no checking method that can be employed which will reveal to the user the exact amounts of linseed oil and other materials that are used in the manufacture of core oil.

It is possible to check the flash and fire points, specific gravity, saponification value and acid number, but the purchaser cannot go back to the core oil manufacturer and claim a deficiency in linseed oil or rosin because the check made will not prove it. The best practice is to secure a reliable manufacturer who can be depended upon for the production of consistently uniform oil.

Mixing Core Sand

An error generally made in mixing core sand is in the use of too much oil. It is much better to use just enough oil to allow handling of the cores. A rammed core, or one that is properly blown, needs but little oil. Another common error in foundries is the addition of more oil to prevent breakage by the careless molder or core handler. It is the author's contention that training employees in the proper handling of cores instead of using excessive amounts of oil will prevent much scrap caused by strains and tears, and also save expensive oil. The use of a minimum amount of core oil will aid in eliminating objectionable gas and odors sometimes present in foundries.

In this foundry it has been found that with the use of a high grade oil and a ratio of 1 part oil to 200 parts sand, and as high a ratio as 1 to 400, good cores for automotive malleable will result. By using such small amounts of oil the amount of water can be increased at mixing time without encountering trouble due to the standing of cores in the green state. This will aid in producing a good surface finish when using corn cereal binders, due to the migration of dextrine to the core surface at baking time.

In preparing a new core, basic information as to size of core and shape and size of the cavity to be cast is available, but the proper amount of core oil is not known. Therefore, to be on the safe side, it is common practice to use more oil than necessary. If a good casting is produced on this first try, a check is seldom made as to maintaining, or perhaps improving, castings quality with the use of a lesser amount of oil. A casting produced with less oil will be less liable to strains or the possibility of tears, in addition to savings resulting from the minimum use of expensive oil.

Cereal Binders

Corn Flour Binders. Use of corn flour is a general practice in making cores for malleable iron castings because of the high amount of green bond obtained without ill effects during casting. A number of corn flour binders are made by the wet-and-dry process. The author feels that the wet-process material has an advantage in that it will tolerate a greater amount of water at the time of mixing. This will aid the foundry having no drying equipment for raw core sand.

It is sometimes assumed that the checking of cereal binders is not important, as there is no reason for the binder to contain any material other than corn; yet samples checked by

Presented at a Malleable Foundry Practice Session of the Fiftieth Annual Meeting, American Foundrymen's Association, at Cleveland, May 7, 1946.

the burning method have been found to contain as much as 3 per cent clay or bentonite mixed with cereal binders.

Core Sand Mixing. In manufacturing automotive castings it is well to use as little bonding material as possible. It is the author's opinion that the exclusion of clay in core sand mixtures will produce better castings and require less core oil, with a resulting decrease in scrap. Clay additions force an increase in the amount of oil, producing a core which is hard all the way through, causing tears, cracks and strains in the castings. Where the need is found for higher hot strength to prevent gate burn-in, a far better practice is to paint the cores at gating points with a silica wash.

Batch Components

Core sand mixing is an important operation. Components of each batch of sand should be ascertained and recorded, as this is the only means by which results can be checked.

A number of different types of core sand mixers are available, some capable of thoroughly mixing a batch of core sand in 3 min., while others take as long as 10 min. The following method is suggested for checking the proper mixing time cycle:

Weigh or measure the sand and flour—mix together for 1 min. Then add water and oil, running total mixture an additional ½ min. Start taking test samples of sand every ½ min. until 20 samples have been taken, being careful to mark the time on each. After the 20 samples have been taken, three tensile strength test cores are made from each. Bake and cool carefully, check each for core hardness, and then run tensile strength tests. The first test samples will have a wide range of strength, but as testing proceeds the range narrows until the values are closely grouped. Proper mixing time is that of the test sample developing the highest strength, and mixing beyond this time is of no value. A few of the various core sand mixtures in the foundry with which the author is associated are shown in Tables 1 and 2.

In conclusion, it is recommended that foundries making automotive malleable iron castings observe the following points: Know the sand and mixing cycles; be certain of the oil and oil manufacturer; use as little core oil as possible; bake cores until all oil is thoroughly oxidized, leaving the core an even brown in color, and the castings will be sound as far as the cores are concerned.

DISCUSSION

Chairman: A. M. FULTON, Northern Malleable Iron Co., St. Paul, Minn.

Co-Chairman: C. F. JOSEPH, Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich.

MR. JOSEPH: Did you run tests on various core oils to determine the best oil for use or have you just standardized on one oil and continued using it over a period of years? What is your practice in selecting your core oil?

MR. FERRELL: Over the period of a great number of years the picking of core oil was rather a haphazard procedure. We then adopted the chemical method of checking core oils, and that was not satisfactory. We then employed a research chemist to determine why we could not select a core oil.

There are three or four things which may be checked in a core oil. However, these do not always indicate exactly what is wrong with an oil. We have found it most satisfactory to purchase oil from a reliable manufacturer and take his word for it. We buy the best core oil there is and use as little as possible, depending on the reliability of the manufacturer.

DAVID TAMOR[1]: Can you tell us something of the hardness that you obtain in your production cores?

MR. FERRELL: The scratch hardness runs anywhere from 65 to 85 on regular production cores. We use a very soft core. It may be surprising to some men why we use such a soft core. We malleablize our iron of 1.40 to 1.60 per cent silicon in 15 hr. in electric roller-hearth continuous ovens.

MR. TAMOR: Is the 65 core hardness for extremely thin work, where you want collapsibility?

MR. FERRELL: That is right. The range is fairly high. Where we run low collapsibility we encounter very thin castings where we are in danger of getting cracks or tears.

E. G. STORIE[2]: What type of mixing equipment is most satisfactory?

MR. FERRELL: We find that a fast-action mixer is better for core sand.

P. R. SCHILLING[3]: Is there any reason, if you use such a diluted mixture of 1:200, that you would not find it profitable to stick to straight linseed oil?

MR. FERRELL: We have not because that necessitates a drier. Linseed oil is not rapidly oxidized. It requires an accelerator. The core should not be in the oven very long when it contains so little oil. If the core is in the oven a long time, the oil burns up leaving cores with no bond.

VICTOR PASCHKIS[4]: Has any attempt been made to bake the core by dielectric heat? You mentioned that the time of keeping the core in the oven has some bearing, and of course the time of oxidation has. In dielectric heating, you heat the core all the way through, and technically it should be superior, although it may not be economically possible to do so.

[1]American Chain & Cable Co., York, Pa.
[2]Fittings Limited, Oshawa, Ont., Canada.
[3]Superior Steel & Malleable Castings Co., Benton Harbor, Mich.
[4]Columbia University, New York.

Table 1

CORE SAND MIXTURES

Components, Properties	*Rear Axle Carrier, Main Body Core*	*Slab Type Gate Core*	*Front Wheel Hub Core*	*Truck Differential Case, Body Core*
Lake Sand, lb.	400	400	400	400
Cereal Binder, lb.	4	4	4	4
Core Oil, No. 45, pt.	1½	1½	—	—
No. 110, pt.	—	—	1½	1
Moisture, per cent	2.5	2.5	—	—
Green Permeability	205	219	—	—
Dry Permeability	253	243	—	—
Tensile Strength, psi.	105-110	175-180	55-60	55-60
Surface Hardness	60	70	—	—
Sintering Point, °F.	2417	2467	—	—
Baking Time, hr.	—	—	1	1
Temperature, °F.	—	—	450	450

Table 2

LAKE SAND SCREEN TEST

Screen Mesh No.	*Retained on Screen, %*
6	0.0
12	0.0
20	0.0
30	0.0
40	1.0
50	21.0
70	62.5
100	14.4
140	1.1
200	0.0
270	0.0
Pan	0.0

Grain Fineness No. 51.13

MR. FERRELL: We are now working on that, and have purchased a dielectric heating machine of 12 kw. size for that purpose. It looks as though only 3 or 4 min. would be required to bake a core which formerly required 1½ hr. of baking time.

CHAIRMAN FULTON: What type of core and what section of core is made with a 1:400 mixture?

MR. FERRELL: That mixture is used in a very thin slab core for Ford castings. We have one particular Ford casting that has a very thin band around it. We find that with 1.40 and 1.60 per cent silicon iron, we are forced to use practically no oil or the casting will crack. That is where we use the 1:400 mixture.

EARL M. STRICK[5]: In mixing the core sand, is there any difference in adding the oil or the water first?

MR. FERRELL: Our experience has been that adding the oil first does not produce results equivalent to adding the oil after the water. Our experience and tests prove that the water must be added before the oil to get efficient bonding action. Our total mixing time is 2½ min.

CHAIRMAN FULTON: Do you start your mixture from a dry sand?

MR. FERRELL: Yes.

CHAIRMAN FULTON: Then you know definitely the amount of moisture?

MR. FERRELL: We do. We dry all core sand coming into the plant.

F. L. HARRIS[6]: Have you any hot strength tests to correspond to the hardnesses 65 to 120?

MR. FERRELL: I think there are some in the paper. Are you referring to sintering tests?

MR. HARRIS: I was thinking more of the hot strengths at 2000° F., in other words, collapsibility that you get with those hardnesses.

MR. FERRELL: I do not have them. All I can give you are the sintering points. We find sintering of the 1:400 mixture occurs at 2467° F.

MR. HARRIS: Do you have tensile strengths that correspond with those hardnesses?

MR. FERRELL: We do. The potential strength on these cores will run 110, 110, 105, 110. Surface hardness was 6.

MILTON TILLEY[7]: Would you describe your core-baking process? Do you put all sizes of cores through the same oven? What are the baking time and temperature? Do you over-bake your small cores and under-bake your large cores? Do you do all your baking in the oven, or does some take place outside the oven?

MR. FERRELL: We try to bake the cores completely in the oven in order to get rid of the smoke. We do segregate the large cores. It is impossible to bake all the cores with that small amount of oil in the same oven. So our baking temperature is 450° F. and our time is 1 hr. and 10 min. in the oven.

O. J. MYERS[8]: I was interested to learn of your test for mixing the core sand. Is the green bond also influenced by that mix, and do you get maximum green bond when you get your maximum tensile strength?

MR. FERRELL: No. We are interested only in getting the maximum oil out of it, the strength in it. That is why we say that that method of testing is efficient as far as the oil is concerned. We do say that when you reach the end point, when the tensile strength of the core is grouped closely together, there is no further need of going into it. We find a wide range. Of course, different mixers will give you longer times.

MR. MYERS: How much water do you use?

MR. FERRELL: We use 1½ to 2 per cent moisture.

MR. MYERS: Is it put in only for green bond strength?

MR. FERRELL: Yes.

MR. STRICK: Have you tried anything to substitute for corn flour? If so, what affect did it have on the collapsibility of the cores?

MR. FERRELL: The ones we have tried have affected it very badly. We have used wheat flour and other forms of flour. We have used other chemical compounds. We have not found one that produces the desired results. As a matter of fact, we are going back to regular malleable iron because the 1.40 to 1.60 silicon iron requires very collapsible cores.

G. L. GALMISH[9]: What happens if you run 1.40 to 1.60 silicon?

MR. FERRELL: The iron is very prone to hot tear, and there are certain shapes of castings that cannot be manufactured with it. It makes a good malleable iron after it is annealed.

B. L. HAYS[10]: Are most of your cores made on blowers?

MR. FERRELL: About 95 per cent of our cores are made with blowers.

CHAIRMAN FULTON: Do you find that a blown core requires more or less oil than a rammed core?

MR. FERRELL: We do not need as much oil in the blown core. We find the blown core gives us better results for it has greater permeability than the rammed core.

MR. STRICK: Do you have iron penetration caused by some of your cores? If so, what do you do to eliminate it?

MR. FERRELL: We have very little iron penetration. If we have iron penetration in the gates, we put a little core wash there, rather than increase the oil for in our condition we dare not increase the oil. That would increase the hardness, and we must avoid that. We use a little surface core wash when we get iron penetration.

CHAIRMAN FULTON: We assume then that the higher silicon content iron you run, the softer the core you use.

MR. FERRELL: That is correct. It is not possible to make the grade of high silicon iron using hard cores. Our cores are so soft we have to make special containers to handle them. They are set in at the core room and carried to the molder in those containers. The cores have to be handled very carefully.

CHAIRMAN FULTON: Do you get many cracked castings due to cores?

MR. FERRELL: I do not think a soft core will cause a crack. We know that lack of collapsibility is the cause of tears. Strain cracks may be caused by something different, possibly gating.

MR. TAMOR: Would you comment on the use of wood flour to produce a collapsible core with thin walls?

MR. FERRELL: We do not use wood flour. We have tried it and found no advantages.

MR. TAMOR: I do not think there is much question but that wood flour in cores gives good collapsibility. It will impart it to molding sand. The reason we are using corn flour is to get green strength and collapsibility. Wood flour will give collapsibility but will not give green strength in the cores, and you have to use something else with the wood flour which probably gives you a harder core and less collapsibility in the finished product.

[5]Erie Malleable Iron Co., Erie, Pa.
[6]Belle City Malleable Iron Co., Racine, Wis.
[7]National Malleable & Steel Castings Co., Cleveland.
[8]Werner G. Smith & Co., Minneapolis.
[9]Michigan Malleable Iron Co., Detroit.
[10]Union Malleable Iron Works, E. Moline, Ill.

BOOK REVIEW

Metallurgy, by Carl G. Johnson. Third edition, seventh printing, 416 pages, 225 illustrations. Price $5.00. American Technical Society, Chicago 37. 1946.

Metallurgy is an elementary textbook on the subject, dealing primarily with physical rather than chemical metallurgy. Standard topics generally included in textbooks of metallurgy are represented. These include testing and properties of metals; elementary physical metallurgy and theory of alloys; shaping and forming of metals; the properties, production and heat treatment of the basic types of alloys, and separate chapters on cast iron and on powder metallurgy. The fundamentals of chemical metallurgy are covered in one chapter.

Many References

Foundrymen will be pleased to see a number of references to cast metals. Errors in the text on foundry practice are generally minor, although gray iron foundrymen will wonder at the statement on page 82: "The pig iron for casting is melted in a cupola . . . in which coke and pig iron are charged . . . "

Steel foundrymen may resent the implication on page 82 that only steel castings are subject to defects.

In general the book is well illustrated, but the photomicrographs have lost some of their sharpness, perhaps due to repeated reproduction.

MECHANICAL SHAKEOUT

Design, general layout, sand handling, dust control, costs, and general hygiene are some of the foundry operating factors directly affected by the shakeout installations.

James L. Yates
Construction Engineer
Worthington Pump & Machinery Corp.
Buffalo, N. Y.

SHAKEOUT IS A TERM which, to the average foundryman usually has many particular translations: (1) removing castings from the flasks and separating them from the molding sand; (2) means employed in accomplishing the removal and separation (manual, semimechanical or completely mechanical); (3) the most difficult foundry job to man in the prevailing labor market; (4) the source of the majority of foundry dust, which is rapidly becoming the progressive foundryman's foremost problem because of its effect on general foundry working conditions, and the advent of more stringent state laws governing foundry sanitation and hygiene.

Manual Shakeout

Manual shakeout has been practiced for years and there are many places where it still is the most practical way of freeing a casting from the flask; however, it does not afford much chance of controlling the resulting dust, and poses a further problem of manhandling the sand either to clear the floor or prepare the sand for reuse.

Semimechanical shakeout, such as holding a flask in an elevated position and using a vibrator, is a somewhat faster operation for a given size of flask but often a more dusty operation than straight manhandling. Wear and tear on flasks and crane equipment is high and adequate dust control well-nigh impossible. The sand pile occasioned by shakeout has to be handled by hand or clamshell unless some special conveyor system is available. Sand handling, especially from dry sand mold shakeout, by either manhandling or clamshell bucket, further aggravates the dust control problem.

Mechanical Shakeout

Mechanical shakeout, as the author understands it and further discusses it in this paper, is a device, usually a vibrating deck, upon which flasks are placed and the sand vibrated free from the flask and the casting and deposited in boxes or on a conveyor after passing through openings in the vibrating deck.

A mechanical shakeout system, to the author, is a combination of the mechanical shakeout device itself; the foundation upon which it rests; the dust control system necessary to control dust at the point where made; the conveying apparatus handling the sand shaken out and either storing it for future use or conveying it to other apparatus for reconditioning or refuse; and such other devices as are necessary to adequately feed the shakeout (cranes, etc.) and remove castings and flasks from the mechanical shakeout deck.

The design of a mechanical shakeout system presents five problems:

1. The shakeout device itself.
2. Foundations supporting the shakeout as well as other parts of the system.
3. Dust control apparatus.
4. Equipment for handling the sand from shakeout.
5. Crane, conveyor or other equipment to bring flasks to the shakeout and to take the castings and flasks away after shakeout operation.

Each of these problems has a definite relation to a particular foundry layout and, usually, a change of one element—size, shape, location, or otherwise—affects the other elements of the system.

Assuming that the majority of foundrymen are interested in the application of mechanical shakeout systems to existing foundries, the author attacks the problem from that angle. Treatment of the subject of mechanical shakeout from the standpoint of the design of a new foundry would of necessity be different if one expected to benefit from the improvements made in foundry practice in the last decade.

Shakeout Systems Vary

No one design of a mechanical shakeout system will fit every requirement of existing foundries. Many foundries—such as jobbing foundries—make a wide size variety of castings and require more than one design of mechanical shakeout system.

As to the mechanical shakeout device itself, there are two principal types—each of them much alike and differing principally in the manner in which they are motivated for deck vibration. One type has a straight mechanical drive through an eccentric (Fig. 1) and the other obtains its motion through an unbalanced weight acting on a spring support.

Both types are widely accepted

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and both do an excellent job when properly applied. They are available in many sizes, from as small as 2x3 ft. to as large as 8x10 ft., and when used in multiples they are limited only by the means of getting rid of the sand after it is freed from the flask.

The design of the shakeout device itself has been well worked out by the equipment manufacturers. The foundrymen need not be concerned about mechanical design, but he must be careful to select a size in keeping with his requirement and his pocketbook because the device itself usually represents but a small part of the cost of a mechanical shakeout system.

Grate Openings

In addition to the matter of shakeout size, there is the matter of size of openings in the shakeout grate. There are two schools of thought on this matter, one of which insists upon large openings and passes the work of breaking the lumps to other parts of the equipment, and the other which advocates the smallest practical opening.

With large openings the shakeout deck clears rapidly but usually passes gaggers, tramp metal, sprues, gates, etc., which must be separated from the sand at some other part of the system. Usually, the larger the flask the larger the lumps, especially in dry sand work. The number of gaggers likewise increases, quite often out of proportion to the increase in flask size.

By the same token, large flasks are not handled as rapidly as smaller flasks, and the time required for one flask through the shakeout operation ordinarily is sufficient to allow the sand to flow through small holes. Sand lumps not passing through the small openings are crushed when the next flask is placed on the shakeout.

On the basis of personal observation and experience, the author leans to the smallest practical opening. With a maximum opening 1¼x 4 in. on a vibrating deck 12x33 ft. with a shakeout area of 396 sq. ft., and handling lumps of dried sand 8x10x6 in. that will support an average man's weight, it has been found that practically all of the lumps will break up and go through the deck by the time the crane crew can remove and land the flask, pick up and land the casting and deposit another flask on the shakeout. Any lumps that remain are quickly crushed when the next flask is landed on the shakeout deck.

Green Sand

On shakeout decks 36x42 in., it has been found that green sand readily passes through openings ¾x3 in. On large shakeouts, say 5x6 ft., openings of 1x3 in. have proved quite satisfactory.

In handling small, dry sand flask shakeouts, again with reasonably hard lumps 3x3 in. openings are satisfactory; as a matter of fact, the original openings have been reduced from 3x3 to 1¾x3 in. It has been found that fewer gaggers pass through the smaller openings, with correspondingly less trouble in the conveying system and less wear and tear on conveyor belts.

Foundations

Foundations for shakeout devices, especially those shakeouts intended to handle extremely large flasks, i.e., flasks 10x30 ft. and weighing upwards of 50 tons, require careful consideration of many factors:

1. Location of the shakeout with relation to building supports.
2. Character of the ground on which the foundation is to rest.
3. Piping and waterproofing.
4. Proximity of the shakeout to adjacent buildings or property owned by others.
5. Shakeout location with reference to chemical or metallurgical laboratories where sensitive balances are used.
6. Location with respect to machine tools that turn metal, either by cutting or grinding.
7. The usual considerations for the location of heavy equipment in relation to crane facility, material flow, chipping room, sand storage and proper placement to suit general foundry layout.

In general the foundation is found to be appreciably larger than the shakeout deck area, and often is supported on steel which spans the foundation walls in order to provide room for the hoppers receiving the sand as it cascades through the shakeout deck, room for the feeders and conveyors taking the sand from the hoppers, and working room for the operator who must grease the conveying apparatus and tend such other devices as are in the pit. Furthermore, a means of drainage should be provided because some water will get into the pit in spite of all preventive measures.

Pit Construction

On large shakeout installations, the pit over which the shakeout device is mounted is constructed with at least 6 ft. of headroom and, when allowance is made for pit floor and pit roof, the excavation is down 8 ft. or more below the foundry floor level. This depth is greater than that of the average crane column footing, and quite often means underpinning the building column or making the pit wall heavy enough to take the load due to the column footing; therefore, as previously

Fig. 1—Twenty hp. multiple "V" belt drive for one of the 6x10-ft. sections of the shakeout. Motivating counterweight and spring supports in the center.

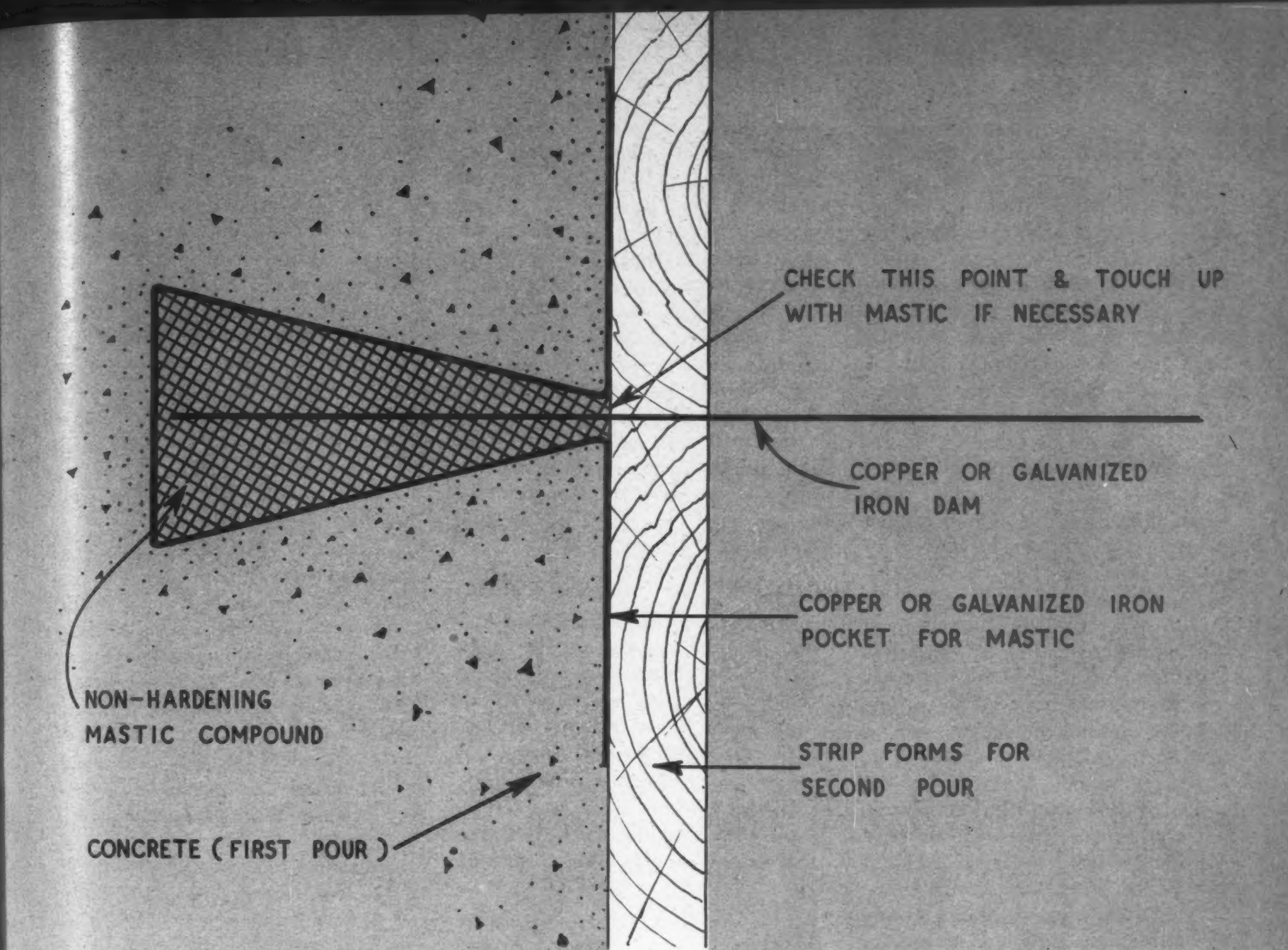


Fig. 2—Sketch showing method of making vertical construction joints in concrete pit of shakeout installation.

pointed out, it is important to consider shakeout location with reference to building columns or supports.

Consideration of ground or soil characteristics is most difficult, unless one is familiar with them through previous foundation experience in the immediate area. Any condition from hardpan to quicksand may be encountered. However, good foundations can be placed in any sort of ground, provided that precautions are taken to make the foundation design suit prevailing conditions.

All vibrating shakeout devices have shaking forces, some more so than others, and there are times when the minimum shaking force to be absorbed by the foundation is an important consideration in shakeout device selection from the standpoint of foundation cost.

The location of underground piping is important because it is costly to reroute piping of any appreciable size. Storm sewers and other drainage lines disturbed during excavation often cause no end of trouble by leaking during pit construction, or afterward by seepage through construction joints.

Extreme vigilance on the part of the owner or his agent is required during pouring of concrete if the pits for shakeout installations are to be made watertight. Short cuts taken by contractors often result in water seepage into pits 6 months to a year after a shakeout is put into operation.

The practice of placing metal dams (flat pieces of sheet copper or galvanized iron 6 in. wide) at all horizontal construction joints so that they are half width in the first pour and half width in the next pour is well worth while. Vertical joints require careful treatment, and the metal dam shown in Fig. 2 has worked out well. The best possible waterproofing is none too good when shakeout foundations are placed in normally wet areas.

Next in importance is the location of the shakeout with regard to adjacent buildings, especially dwellings. Shakeouts do make some noise and there are times when it is objectionable, especially if prevailing winds are such as carry the noise to adjacent dwellings. This is especially true if the shakeout works at night when the usual factory or foundry noises are at a low ebb.

Shaking forces which may not be noticeable immediately around the shakeout may cause vibration at distances of 100 ft. or more from the shakeout location and, while they may be of a magnitude difficult to measure, they are sufficient to rattle dishes and other objects and create unpleasant situations for all concerned.

Chemical and metallurgical laboratories with their delicate "balances" and other instruments and chemical glassware are readily disturbed and sometimes made inoperative due to vibration transmitted through the ground, and it is well to keep large shakeouts at a reasonable distance from them. This is especially true in areas where ground conditions are poor.

Experience has shown that

ground-borne vibration of small magnitude will seriously affect the finish on parts that are either ground or turned. There have been cases where machine tools have had to be insulated by non-vibration-transmitting or vibration-absorbing materials in order to prevent foundry-made vibration from affecting the finish on work being machined.

Location of the shakeout determines the location of the foundation, but there are other considerations such as crane facility, material flow, relative chipping room location, sand storage, and proper placement to suit the general foundry layout, and these will be discussed later.

The availability of a crane over the foundation will expedite the excavation, placing of forms and pouring of concrete as well as setting up the equipment which rests in and on top of the foundation.

Refuse foundy sand makes excellent fill around the foundation and can be placed after the concrete has set. If the foundations are outside in the weather and set on clay, it is well to set a tile drain around the foundation in a manner similar to that used in dwelling basement construction due to the fact that, for at least a few years after building, surface water from a considerable area will accumulate in the broken ground around the foundation.

The design of the foundation itself has to suit so many variables that it is difficult to set down any hard and fast rules. In general, foundations are constructed of reinforced concrete, often in conjunction with rolled sections ("I" beams, channels, etc.) set to suit the superimposed equipment, They must be carried down to a solid footing or the equivalent. In all cases, it is well to isolate shakeout foundations from building or crane column footings, building walls, and foundations for other equipment. In special cases, it is well to consider vibration-absorption materials of the rubberized fabrics, rubber or steel spring type, in order to prevent transmission of vibration.

Shakeout Dust Control Apparatus

One of the most important reasons for installing mechanical shakeout is that it affords an opportunity for better control of the resultant dust. Many variables enter the picture and each shakeout installation presents an individual problem.

Shakeout dust usually leaves the flask at a temperature higher than that of the average temperature for the building in which it is located; therefore, it has a tendency to rise and to follow any air movement in its immediate vicinity. In many shakeout operations, steam rises with the dust and further aggravates the problem.

The tendency for dust to rise suggests overhead dust pickup. Unfortunately, overhead space just above the shakeout grate is at premium because it is in the area of flask movement. In general, foundrymen prefer to have no obstruction in the way of flask handling, particularly when overhead cranes are used.

Therefore, it is necessary to compromise between ease of casting handling and the difficulty of handling shakeout dust in directions other than natural flow. Repeated tests have proved that the best dust control is accomplished by arresting and collecting it close to the "point where made."

There are three generally accepted basic methods of dust control:

1. Overhead hoods or partial enclosures.
2. Down draft.
3. Side hoods.

A fourth method, complete enclosure, with openings only large enough to pass the required control air, is being tried in connection with what is thought to be the world's largest completely live-deck shakeout, and it may be that this method will set a pattern for the larger shakeouts.

The "overhead hood" is limited

Fig. 3 (left)—Close-up of 28x9-ft. flask on shakeout during vibrating period. Roof closed. Entire shakeout deck in motion.

Fig. 4 (center)—Close-up of 72-in. diameter by 40-in. deep cope being vibrated. Roof closed. One-third of shakeout deck in motion.

Fig. 5 (right)—Hot mold being transported to flask yard for cooling prior to shakeout.

to smaller shakeouts where the flasks can be upset by hand, or by mechanical, hydraulic or pneumatic devices. It can be made to suit a wide variety of conditions as it is a modification of the complete enclosure. The amount of air (cu. ft. per min.) required to adequately exhaust this type of hood can be figured quite accurately by measuring the area open to indraft in sq. ft. and multiplying by 200. A double-check on this figure can be made by taking the area of the shakeout grate and multiplying by 200. It is advisable to use whichever figure is the greater. The exhaust connection should be at the top of the hood, preferably at the apex of sloping top plates.

Dust Control Systems

Downdraft, as the name implies, is a method of drawing dust, steam and fumes through the shakeout grate by means of exhaust connections in the shakeout hopper. This type of shakeout dust control appeals to the foundry operator because it requires no hood above the floor level and gives the shakeout crew and crane operator unobstructed access to the shakeout grate. Occasionally, downdraft systems are successful, but these installations are the exception rather than the rule.

Some of the reasons for difficulties with downdraft shakeout dust control systems are:

1. The natural path of dust and gas travel is upward, directly opposite to the direction of control air travel; this is particularly true when castings are shaken out hot.

2. The maximum concentration of dust usually is well above the level of the grate and much of the control (exhaust) air bypasses from the floor through the grate with little or no effect in the area of maximum dust concentration.

3. Temporary coverage of the entire grate with sand may completely shut off the flow of control air at the moment of maximum dust concentration.

4. On large shakeouts, conveying equipment usually is of such capacity as to require more time to clear the shakeout hoppers than it does the shakeout to fill them. Consequently, the hoppers act as surge chambers and often are so fully loaded with sand as to completely block the control air connections.

Table 1

RATE COMPARISON ON BASIS OF SEMIMECHANICAL AS AGAINST FULLY MECHANICAL SHAKEOUT

Part	Flask Size, in.	Depth, in. Cope	Depth, in. Cheek	Depth, in. Drag	Castings per Flask	Old Standard, units	New Standard, units
Liner	72 (diam.)	16	28	40	5	214	132
Sheave	72 (diam.)	16	—	16	1	121	88
Engine Frame	92x276	35	—	35	1	997	313
Engine Frame	92x276	17	—	35	1	642	383
Cylinder	60x136	33	—	33	1	370	166
Cylinder	72x90	30	—	30	1	284	113

Table 2

DETAILED RATE COMPARISON BREAKDOWN, SEMIMECHANICAL AND FULLY MECHANICAL SHAKEOUT OF CASTINGS MADE FROM THE SAME PATTERN AND IN THE SAME FLASK

(Engine frame, finished cast weight, 25,000 lb.)

	Cope (35-in. depth)				Drag (35-in. depth)			
	Old Standard		New Standard		Old Standard		New Standard	
	Quantity	Units	Quantity	Units	Quantity	Units	Quantity	Units
Runners	2	18	—	22.8	—		—	
Risers	9	12	—	4.5	—		—	
Bolts	47	56.4	47	56.4	47	56.4	39	46.8
Plates		—		—		8		—
Pick up and store flask		49		35		49		35
Vibrate		556		10		84		4.4
Rollover		—		—		15		11.8
Gaggers and rods		53.3		33		—		—
Casting (removal and handling)		—		—		40		40
Open and close shakeout doors		—		6.6		—		6.6
Total		744.7		168.3		252.4		144.6

Old Rate, Total Units....997
New Rate, Total Units....313

5. As all of the sand from shakeout must cascade through the air being exhausted, much usable sand is picked up in the air stream, tending to overload the control system and waste usable sand.

The side hood offers an excellent compromise for the average shakeout that cannot be provided with an overhead hood. It is readily fitted to almost all sizes of shakeouts and usually blocks only one side of the shakeout. Side hoods can be so placed that the crane operator's view of the shakeout deck is unobstructed, thus aiding in the movement of flasks to the shakeout.

Side hoods usually are of heavy construction, often with reinforcement to stand abuse from careless handling of flasks. Detail design varies considerably, with a great difference of opinion as to the method of distributing air flow into the hood through the hood face; however, there are certain points which are in general agreement, viz:

1. The side shakeout hood should be installed parallel to the long side of the grate.

2. The hood should extend over the shakeout grate as far as possible without interferring too much with flask handling, say, within 6 to 18 in. of the centerline of the grate, depending upon the type of crane hook and slings used. An overhang of at least one-third the grate area is a good starting point, and each additional in. of coverage improves dust control by extending the "reach" of the control air.

3. The length of the side hood is extremely important; it should be longer than the long side of the shakeout in order to prevent bypassing of control air around the end of the hood. Experiments tend to indicate that the wings (the parts of the vertical face of the hood which extend beyond the ends of the grate) need not be provided with air inlet passages; as a matter of fact, they often are more effective if left blank.

End shields at right angles to

the extreme ends of the hood are most helpful if it is possible to use them.

Side hoods are affected by cross drafts and convection currents in the shakeout area, but to a much lesser degree than downdraft shakeout control.

Air volumes of 400 cu. ft. per min. per sq. ft. of gross grate area is a good starting point for air volume required, and some installations run as high as 500 cu. ft. per min. per sq. ft.

Double side hoods offer good shakeout dust control with somewhat less control air, say, 300 to 400

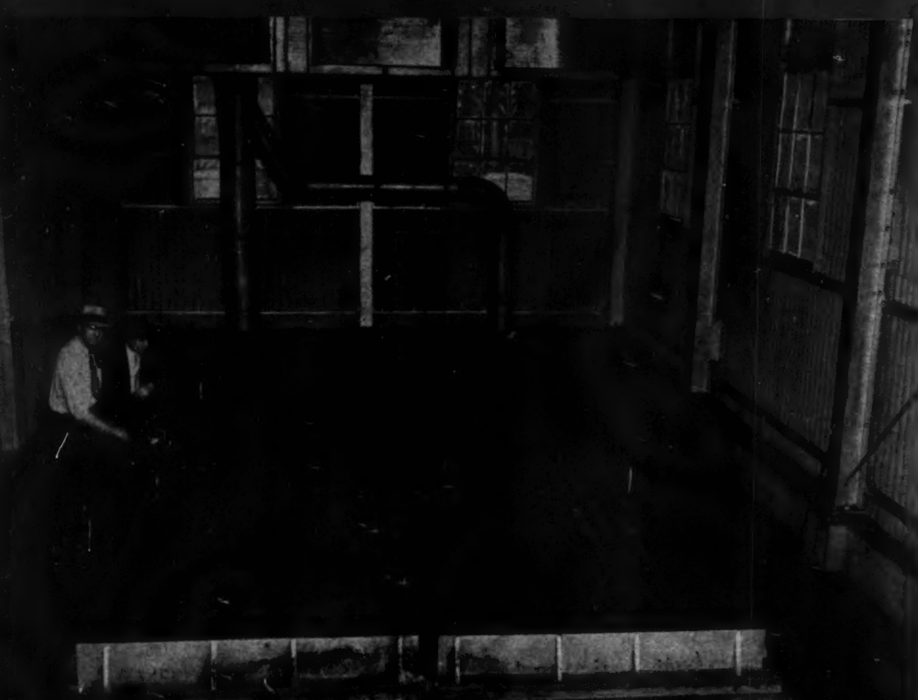
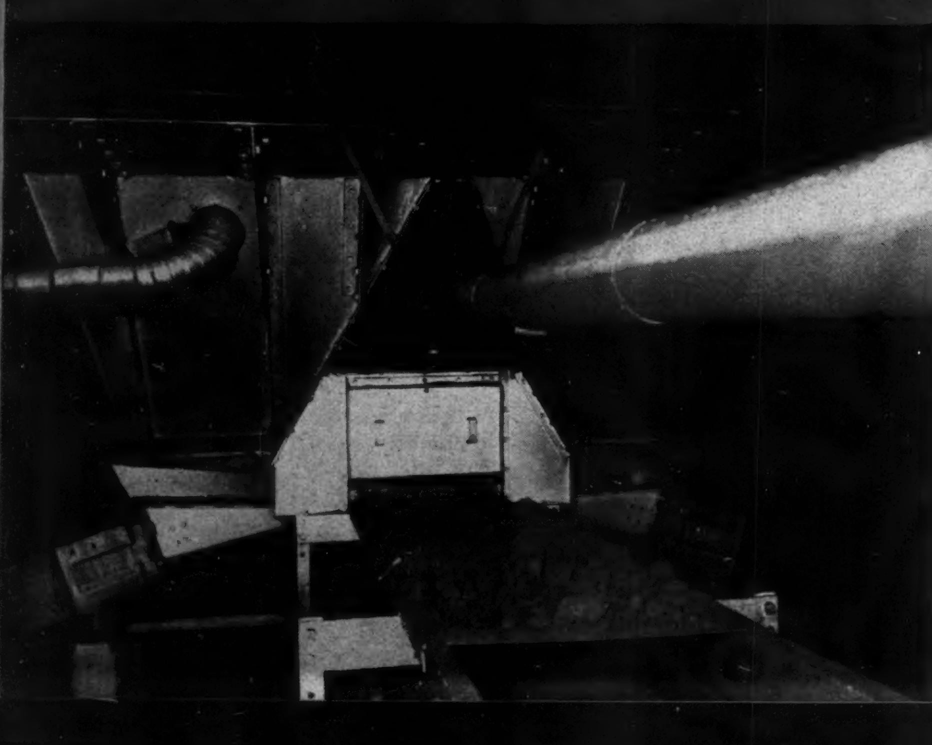


Fig. 6 (top)—General view of main bay showing large molds in the making. Taken before foundry was painted white and large shakeout installed.

Fig. 7 (center)—Interior of shakeout cubicle showing shakeout deck and dust-collecting manifold.

Fig. 8 (bottom)—View in pit under shakeout showing two of the six hoppers and two of the six vibratory feeders discharging to the apron feeder. Pipes shown are downdraft dust collection from hoppers to the left and dust pickup from vibratory feeder discharge and apron feeder housing.



cubic feet per minute.

Canopy type hoods are sometimes used because they fit certain conditions. Picture a situation where castings from shakeout must be delivered to the main bay; the area immediately adjacent to the shakeout is used for making large cores and is swept by a jib crane; the shakeout is fed from a roller conveyor; the sand from shakeout is deposited in a container below, which is removed by overhead crane; and further, that any hood must be movable in order to allow all of the aforementioned functions. Here is

one of the few places where a canopy type hood offers a solution.

Complete enclosure of the shakeout operation has been tried with varying degrees of success. Recently a novel form of extremely large shakeout, which shows every promise of being successful, has been put into operation. This shakeout has been placed in a separate building at the end of the flask storage yard. It has a completely live deck 12 ft. wide and 33 ft. long.

The shakeout enclosure is divided into two compartments, one housing the dust-collecting fan and dust-disposal equipment, and the other the

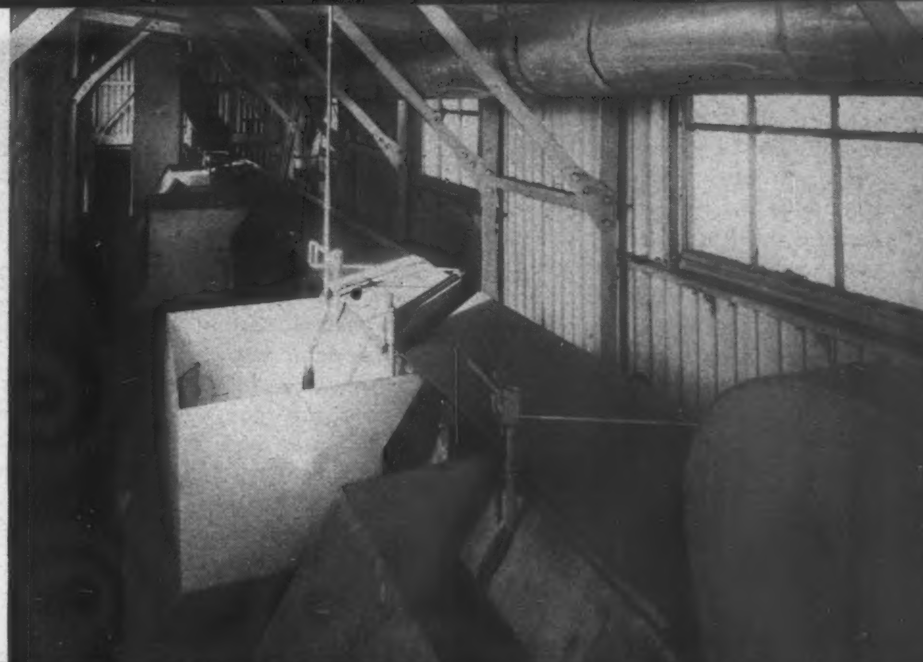


Fig. 9 (center) — Sand handling equipment room. Starting from the left: sludge tank under rotoclone with mud bucket; tramp metal chute and tramp metal box; hexagonal screen housing and fines control; refuse belt at lower right; apron feeder discharge at top right.

Fig. 10 (top)—Sand distribution belt with plows for filling silos. Elevator at far end.

Fig. 11 (bottom)—View showing relation of main foundry to sand storage and handling facilities. Crane door in end of foundry is open.

shakeout itself with the dust-collecting manifold.

The enclosure is arranged with an electrically controlled roof section which exposes approximately 75 per cent of the grate area to the overhead crane, and an electrically operated two-section sliding front door on one of the short sides of the enclosure, which provides an opening wider than the shakeout. Both doors and sliding roof are fitted with limit switches to control movement in both directions.

Dust control is accomplished by a manifold on the end opposite the door (Fig. 3) and air velocity

through the room is controlled by the amount of opening left between the doors when the shakeout is operating. This is variable and, under certain wind conditions, the doors can be left wide open without any escape of dust to the outside atmosphere. When other than the largest flasks are being handled, the sliding room section is opened only far enough to give sling clearance, thus obviating the necessity of removing the slings during shakeout.

In addition to dust control overhead and across the length of the shakeout grate, there are ventilation connections to the hoppers under the shakeout to prevent, insofar as possible, and "dusting" from the hoppers into the equipment tunnel below.

These dust-control connections in the hoppers, constitute a form of downdraft dust control, which tends to control dust at the extreme sides and ends of the shakeout grate. Also, these connections tend to prevent the "upsurge" of dust-laden air, displaced by the large volume of sand released when the sand in the flask "breaks," from the hoppers.

Dust Concentration

Experience with this large shakeout shows that the highest concentration of dust (Fig. 4) is at the time the sand in the flask "breaks," i.e., becomes loose in the flask and, on flasks that are not unhooked from the slings, is the time at which the flask can be lifted clear and taken to the storage pile. By the time the flask has been deposited in storage, the major portion of the sand has passed through the grate and the shakeout enclosure is free of dust. Then the hooker or crane follower can hook up the casting for removal as soon as the crane is back in position. Depending where the type of castings, flasks with the bottom grates removed are shaken out without further dismantling. With other types, the flask is split along the parting line and the casting rolled out before being placed on the shakeout.

Gaggers, rods, risers, gates, shrink bobs and the like are removed from the grate, either by hand or by electric magnet, as required. An attempt has been made to prevent, insofar as possible, any gaggers or other metal going through the grate. Previous experience shows that the majority of forced shutdowns of handling systems and much of the wear and tear on conveyor belts are directly traceable to gaggers in the sand. Much of this difficulty occurs before the sand goes over the magnetic pulleys, and can be prevented by properly sized openings in the shakeout deck.

Handling Sand After Shakeout. Up to this point in laying out a shakeout system, the task is comparatively simple. Beyond this point lies most of the headaches. The principal reason for this is the rapidity with which the modern mechanical shakeout devices release sand from flasks.

Sand is released in a matter of seconds, much faster than it can be taken away except on the smaller shakeouts, where the handling systems must be large enough to take the sand away as fast as it is released from the flasks. Fortunately, the time element in handling the flasks on extremely large installations is such as to allow the sand-handling system to clear the sand from one flask before another is placed in position for shakeout.

Handling systems are tailor-made for a given test set of conditions and vary widely. One of the simplest forms is that in which the shakeout sand is directed into a container that can be lifted by overhead crane and transported to the reconditioning system or other point of treatment.

Another method, and most popular, is that in which the sand is deposited in a hopper under which runs an apron feeder. The feeder in turn deposits the sand on a magnetic belt to remove all iron and steel (gaggers, bars, stools, gates, risers, etc.), and then transfers it to an elevator or other feeding device for transport to storage, mixers or stock pile, as desired.

Shakeout Problems

Large shakeout installations present a number of serious problems.

1. Provisions necessary for rapid handling of huge quantities of sand.
2. Storage facility to keep the sand out of the weather and still immediately available for use.
3. Facility for getting the sand back into the system.
4. Accomplishing all of the foregoing at low cost, considering both cost and operating cost.

As a specific example, shakeout practice and foundry conditions in a large foundry prior to the installation of a large shakeout may be cited.

Large flasks (28 ft. long, 10 ft. wide, and 6 ft. high) were shaken out at night by hanging them in a crane sling and using pneumatic vibrators attached to the flasks, plus the efforts of men with bars and sledges. After shakeout the sand was piled by clamshell bucket and, as required, handled by the bucket into a hopper feeding a synthetic sand preparation system.

The molds, after pouring, were taken to a flask yard to cool (Fig. 5), brought back after cooling for shakeout, and the flasks returned to the flask yard after shakeout to await reuse. All molding in this foundry was in flasks, regardless of size or weight. A sizable portion of the main bay of the foundry, under a heavy craneway, was occupied by a combination of sand pile and shakeout (Fig. 6).

Problem. Cut down shakeout time, rid the foundry proper of sand piles, save wear and breakage of flasks, clean up the foundry atmosphere, and make the area used for sand storage and shakeout within the foundry available for more productive use.

Solution. (a) Mechanical shakeout; (b) mechanical sand handling; (c) outside sand storage.

Large Unit Required

The size of shakeout required was larger than any single unit shakeout on the market, making it necessary to combine six units in order to get the required area.

As it works out, a unit made up of a multiplicity of smaller units has flexibility that is definitely advantageous to the jobbing shop type of foundry (Fig. 7). True, there is the problem of making individual units work alone or in unison with others, but this has been successfully worked out.

The question as to hole size through shakeout grates has been settled on the basis of the smallest holes possible that will allow the grate to clear in a reasonable time without passing gaggers, etc. Openings of 1¼x4 in. have proved capable of handling sand lumps 10x10x8 in. and hard enough to support an average man's weight.

Each of the six 6x10-ft. units that make up the fully live deck or grate is individually controlled so that any one or any combination, including all six simultaneously, can be operated. A 9-in. ledge around the outside edge of the shakeout prevents spilling of sand, regardless of how the shakeouts are operated.

Sand Hoppers

Sand from the shakeout drops into individual hoppers, each fitted with an exhaust connection to control dust generated within the hoppers themselves, and further arranged to deposit sand onto vibrating feeders which, in turn, discharge onto a steel apron conveyor (Fig. 8).

Each vibratory feeder is individually controlled through a half-wave rectifier, and so arranged that the rate of feed onto the apron can be controlled by the operator. This arrangement prevents sand sticking in the hoppers, uncontrolled overloading and jamming of the apron feeder, and further allows accelerated movement of sand when shaking out smaller flasks.

From the apron feeder the sand discharges onto a magnetic pulley, and then into a revolving, hexagonal screen. Tramp metal is discharged into a box on a narrow-gauge car so that it can be pushed out under the overhead crane (Fig. 9).

Coke, cinders, and lumps which will not pass through the screen are discharged to a refuse belt and conveyed to a box under the main crane.

The hexagonal screen is provided with an air curtain which can be adjusted to control fines pick-up as required to maintain proper permeability of the sand before it goes to storage or to the mixers.

After cascading through the air curtain the sand lands on another magnetic belt, and small pieces of tramp metal and a considerable quantity of iron oxide in the form of flask scale, etc., are taken out. The magnetic belt discharges onto a cross conveying belt under ground, which runs under two 250-ton capacity salt-glazed tile silos to the boot of an elevator.

The top of the elevator (Fig. 10) is arranged to discharge either to storage in the two 250-ton silos, or into the sand feed bin directly over the muller in the foundry, simply by changing the position of the flop gate.

Sand from either of the storage silos can be tranferred to the foundry by opening gates over the cross conveying belt and again using the elevator with the flop gate set to discharge to the foundry conveyor (Fig. 11).

Dust control of the shakeout is as previously described, with wet rotoclones handling the dust and automatically discharging it as a wet sludge. Control of the system dust, from transfer points, fines control, tunnel, and etc., is handled by a second rotoclone, again with the dust being discharged as a wet sludge.

Considering that the air drawn into the shakeout enclosure may be at freezing temperatures and that water is sprayed into the rotoclones to collect and wash out the dust, provision has been made to supply heated water to the shakeout rotoclone. The shakeout cubicle is not heated, and no trouble has been experienced in taking air directly from the atmosphere at temperatures down to 10° F.

First and foremost result of the installation is the cleaner foundry atmosphere, which has prompted the use of white paint on all interior walls of the foundry, with a gray dado. All equipment and bins are painted aluminum, jib cranes aluminum with yellow stripes, and all overhead cranes yellow.

Overhead lighting is seldom necessary during daylight hours. Windows, skylights, reflectors and light bulbs require less cleaning. Light reflection from white paint is greater and the whole atmosphere brighter.

Washroom Facilities

Up-to-date washrooms, in keeping with the generally cleaner foundry, make the foundrymen the cleanest and best street-dressed group coming into and leaving the plant.

Mechanical shakeout has contributed heavily in making this foundry a pleasant place to work. Furthermore, it improves foundry production and decreases cost by eliminating much of the laborious work and making it possible to do the remaining work efficiently.

Examples taken at random from rate cards are listed in Table 1 and show over-all shakeout savings made possible through the use of mechanical shakeout. These figures show only reduction in rates for a given operation and not the benefits from the large number of intangibles, all of which tend to improve other operations and contribute to greater production and lower costs.

Large Shakeout Advantages

Further, it is apparent that by and large a mechanical shakeout can handle molds faster than they can be fed to it; therefore, in projecting expected savings through the use of mechanical shakeout, they must be predicated on the slowest link in the chain, which usually is transportation of the flask to and from the shakeout.

An example of this is shown in Table 2, which gives a comparison of rates on semimechanical as against fully mechanical shakeout of the same flask and casting. The actual shakeout time is vastly reduced, but other factors, which are part of the complete cycle of operations, remain the same.

DISCUSSION

Chairman: JAMES THOMSON, Continental Foundry & Machine Co., East Chicago, Ind.

Co-Chairman: C. P. GUION, W. W. Sly Mfg. Co., Chicago.

MEMBER: How much area do you have through the door opening?

MR. YATES: We have not yet determined what the minimum is going to be. We have a 36-in. rotoclone handling that room. According to the New York State Code, we would have to have one twice or three times as large. Fortunately, however, the New York State Code does contain a clause which makes it possible for a properly engineered job that comes out with the desired result to use other than the stipulated velocities and the cfm. per sq. ft. of grate area as given in the code.

In this particular installation we are under very close scrutiny. There are dwellings immediately across the street from the shake-out. On the other side, there is a public park. Any dust or any smoke that gets away from this plant is immediately spotted and it does not take 15 min. before the Smoke Abatement Inspector calls it to our attention.

On the operation of the shake-out, we can set the doors as we see fit and believe we can adequately control the dust with a comparatively small amount of air. This shake-out figures at about 125,000 cfm. We are doing it with something less than 50,000 cfm.

WEST COAST TOUR
Of National Officers Warmly Received

A.F.A. NATIONAL PRESIDENT S. V. WOOD, Minneapolis Electric Steel Castings Co., Minneapolis, completed on October 22 a month's tour of West Coast chapter areas. He was accompanied by National Secretary W. W. Maloney, Chicago. It was the first such official tour that has been possible in some five years.

Leaving Minneapolis on September 28, the National Officers visited Seattle, Portland, San Francisco and Los Angeles on official business, during the course of which both addressed regular chapter meetings, special management groups and chapter boards of directors, in order to bring West Coast foundrymen up to date on activities of the American Foundrymen's Association and to express the cooperation of the National Organization with foundrymen in the Far West.

Arriving in Seattle September 30, President Wood met with a local steering committee formed for the express purpose of initiating an A.F.A. chapter in that area. Top management representatives of surrounding foundries were invited to a special dinner, at which the purposes of the association and advantages of membership and chapter activities were explained. At a general meeting two days later, authority was given the local committee to submit a petition for formation of a Washington chapter headed by C. M. Anderson, Eagle Brass Works, Seattle, as Chairman, and George Rauen, Olympic Foundry Co., Seattle, as Vice Chairman.

Visit Oregon Chapter

Following their successful sojourn in Seattle, the National Officers visited Portland where they met with the Oregon Chapter Board of Directors headed by Chapter Chairman W. R. Pindell, Northwest Foundry & Furnace Works. Here, too, President Wood and the Secretary were privileged to address a specially called meeting of top management, and received from them assurance that their companies would continue interest in the local chapter and urge their employees to play an active part in its affairs.

At the board meeting, President Wood complimented the organization on its steady growth since formation in March 1945, and assured the Directors that the National Organization would make every effort to obtain speakers from among eastern foundrymen visiting the West Coast. On October 5 some 30 members of the chapter turned out for a motor cavalcade to accompany the visitors on an inspection trip to Bonneville Dam. At both Portland and Seattle, a number of plant inspections were held.

Leaving the Pacific Northwest, the President and Secretary next visited the San Francisco Bay area, where they inspected a number of foundry plants and held several meetings with members of the Northern California chapter. On October 9 they attended a special meeting of the Board of Directors, presided over by Chapter Chairman Richard Vosbrink, Berkeley Pattern Works, Berkeley, to discuss chapter business and means of obtaining greater interest in A.F.A. from California foundrymen.

Address Foundrymen

The following day President Wood and the Secretary attended the Annual Golf Party of the chapter, held at the Mira Vista Country Club, Berkeley. Some 80 members enjoyed the afternoon of golf and other sports and the visitors addressed the dinner meeting briefly, bringing the greetings of the National Directors and Headquarters Staff. Present at the dinner was National Director S. D. Russell, Phoenix Iron Works, Oakland, long an active member of the Northern California chapter.

During their stay in San Francisco, the National Officers inspected the Civic Auditorium with a view toward a future West Coast convention of A.F.A. The enthusiasm of California foundrymen for a foundry convention indicated that the first Annual Meeting of A.F.A. to be held on the Pacific Coast may not be far distant.

Dropping down to Los Angeles, President Wood and Secretary Maloney rounded out their West Coast trip with an inspection of the Southern California chapter, commencing with a Board of Directors meeting October 16. Chapter Chairman W. D. Emmett, Los Angeles Steel Casting Co., presided at the board meeting, at which time numerous questions were answered concerning chapter operations and means of maintaining the interest of members in the greatly enlarged Los Angeles area. The following day President Wood addressed a special meeting of top management. He called attention to the great foundry opportunities in California, whose population has increased 100 per cent in the past ten years. Operations of the National Organization and their effect on the local chapter were emphasized by Secretary Maloney.

Attend Meeting

On October 18 the National visitors attended a regular meeting of the chapter held at the Roger Young Auditorium, with over 125 members present. During the week opportunities were afforded to visit a number of Los Angeles foundry plants, where evidence was seen of the progressiveness of Southern California foundrymen.

In concluding this trip President Wood stated that, in his estimation, the chapters on the West Coast are well-founded and intensely interested in bringing to their membership greater information on the production and quality of cast metals. He expressed the hope that more foundry operators from the eastern states would visit the Pacific Coast in the near future, not only to speak before the established chapters there, but also to see for themselves that the West Coast foundry industry is well equipped to serve the needs of a steadily expanding western industry.

Illinois Chapter Names G. H. Rockwell Officer

NEW SECRETARY-TREASURER of Central Illinois A.F.A. chapter is G. H. Rockwell, Caterpillar Tractor Co., Peoria, Ill.

Mr. Rockwell replaces C. W. Wade, formerly of the same firm, who has resigned the chapter office to which he was recently re-elected, due to his leaving town to accept the position of superintendent, Indianapolis Brass Foundry, Indianapolis.

BRONZE CASTINGS

CONDITIONS OF FLOW

J. T. Robertson
and
R. G. Hardy
Naval Research Laboratory
Washington, D. C.

IT IS GENERALLY UNDERSTOOD that the design of the gate exerts a fundamental influence on the quality of the cast metal. The cleanness of the metal, proper directional solidification in the casting, and economical removal of the gate necessitate careful design of the gate and the location of the runners leading to the casting.

Much has been published in an effort to establish the general principles of good gating practice for various metals. Certain techniques have come to be accepted as being generally applicable to a particular type of casting or to a specific alloy but, in general, each casting is an individual problem.

This investigation was a study of the physical condition of some bronze alloys flowing in commonly used gating systems. The purpose of the work was to find the effect of various foundry conditions on the behavior of flowing bronze, and to establish some fundamental principles which could be applied to copper-base alloys in any type of gating system.

Review of Previous Work. A properly designed gate should introduce metal into the mold in such a way that: (a) proper directional solidification may be obtained, (b) the gate may be easily removed, and (c) the casting will be free from dross. This investigation is mainly concerned with the third requirement, that is, gating to prevent dross in castings. Dross arises from two sources; dross on surface of the metal in the crucible carried through to the casting, and dross formed by turbulent flow of the metal within the mold.

Several methods have been recommended for removal of dross before the metal reaches the mold cavity. Higgins[1], Lehman[2], and Crown[3], have discussed the importance of pouring basins. Dross from the crucible should float on the surface of a reservoir of the metal in a properly designed pouring basin, and only clean metal should enter the gate below. The pouring basin must be kept full, and the pouring stream directed so that metal does not flow directly down the sprue, but remains in the pouring basin long enough for the dross to rise to the surface.

Some factors influencing laminar and turbulent flow in bronze castings have been investigated with gun metal, manganese bronze and aluminum bronze. The diameter of the gate was one of the most important factors governing the linear velocity of the molten metal. Laminar flow produced the best mechanical properties, surface conditions and fracture of aluminum bronze. Laminar flow also was beneficial to manganese bronze, but had little influence on mechanical properties, surface or fracture of gun metal.

Various types of gates have been designed to trap dross in the gating system and thereby prevent it from entering the casting. Higgins[1], Crown[4], Hensel[5], and Roberts[6] recommended that a strainer gate consisting of a sand wafer core containing numerous small holes be placed across the ingate or downgate to hold back the dross.

Other types of gates for retaining dross include one with a dead end to receive the first dirty metal[6], a small dummy skim riser before a constriction so designed that dross will float up into it[6], and a "swirl" gate which utilizes the centrifugal force of swirling metal to permit only clean metal to continue to the casting.

Even though the metal flowing through a gate is clean, dross may be produced when the metal leaves the gate and enters the mold cavity. This is especially true of aluminum bronze.

In the casting of some alloys the metal is poured directly into the riser in order to help promote directional solidification [1, 8, 9, 10, 11]. However, most proponents of direct riser pouring agree that this cannot be done with a drossy metal such as aluminum bronze because of the creation of dross by the splashing of the metal as it reaches the bottom of the mold. For this reason, most foundrymen recom-

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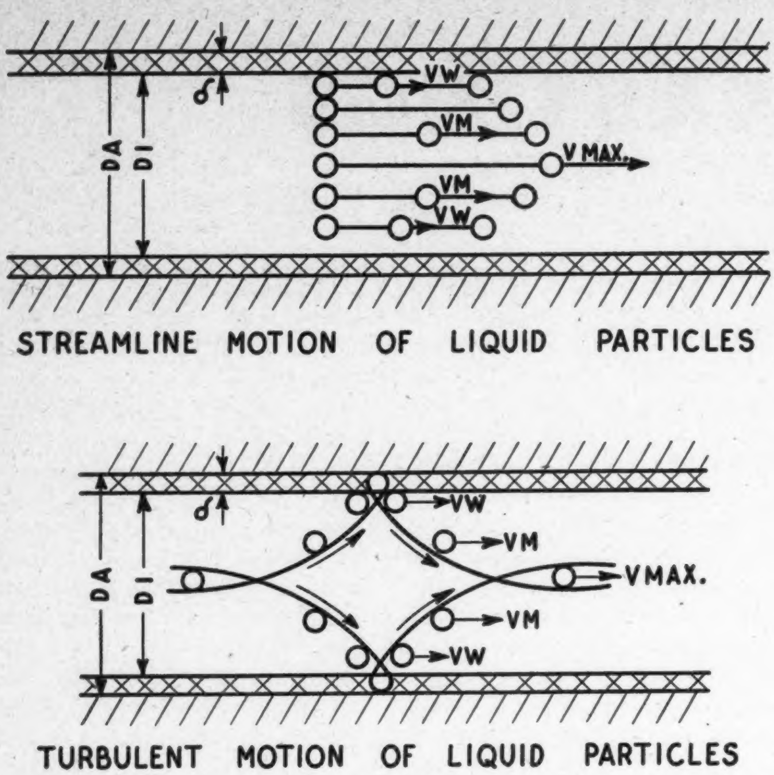


VMAX. = VELOCITY OF FLOW AT CENTER.
VM = AVERAGE VELOCITY.
VW = VELOCITY OF FLOW NEAR MOLD WALL.
DA = DIAMETER OF FLOW CHANNEL.
DI = INNER FLOW DIAMETER.
δ = THICKNESS OF STATIONARY ZONE NEAR MOLD WALL.

Fig. 1—Diagram showing streamline and turbulent flow conditions.

mend bottom gating for alloys which form dross [3, 4, 5, 9, 11, 12].

Even when a casting is bottom gated and the metal does not splash upon cores or projections of the mold, dross still may be produced if the metal is in a turbulent condition. Reversed horn gates are useful for preventing such turbulence [4, 12]. The horn gates should be used in the "reversed" position, that is, the large end of the horn gates should be adjacent to the casting. If the gate is used with the small end next to the casting, the jet caused by this constriction produces severe turbulence.

Lipps[13] and Ruff[14] explain how turbulence produces dross (Fig. 1). Streamline flow is characterized by all of the particles of the fluid moving in a straight line in the direction of flow. Turbulent flow is characterized by motion back and forth transverse to the axis of the stream. This turbulent flow results in new metal always coming to the surface of the stream, oxidizing and forming dross. In streamline flow, the same metal is always at the surface so that only a thin oxide layer is formed and relatively little dross is produced.

It is sometimes possible to calculate whether turbulent flow or streamline flow is taking place as a fluid flows through a circular channel when the velocity of the fluid, its viscosity and the diameter of the channel are known. According to Reynolds' formula:

$$Re = \frac{DVP}{u}$$

where
D = diameter of channel in ft.
V = velocity of fluid in ft./sec.
P = density of fluid, lb./ft.^{3}
u = viscosity of fluid in lb./sec. ft.
Re = Reynolds' Number.

A fundamental relationship has been established between the Reynolds' number and the friction factor (calculated from pressure drop due to friction) for fluids flowing through pipes[17]. The abrupt change in the slope of the curve at Reynolds' numbers of approximately 2,000 to 4,000 is the result of fundamental differences in the nature of flow above and below this region. Applying this relationship to the present problem, it may be surmised that if Re is less than 2,000 the flow should be streamlined, assuming that molten metals behave as do other fluids[17].

If conditions are such that Re is greater than 2,000, then flow may be turbulent. The viscosities of some copper-tin alloys have been measured[15] and found to be within the range for which the foregoing data were obtained. If the velocity of the copper-tin alloy in the gate is known, then the diameter of gate which will produce streamline flow can be calculated.

Velocity Measurement

Although the importance of the rate of pouring has been recognized, few investigators actually have made measurements of the velocity of molten metal in sand molds. It usually has been assumed that formulas for flow of water in pipes may be applied to the flow of metals in molds. The following formula is often quoted:

$$V = K\sqrt{2gh}$$

in which
V = velocity of efflux in ft./sec.
g = acceleration of gravity 32 ft./sec./sec.
h = height of reservoir in ft.
K = a constant.

Dwyer[10] offers a formula for calculating the length of time necessary to fill a mold. It is not evident whether this formula was derived from theoretical considerations or empirical observations. Benkoe[16] presents a theoretical formula for the velocity of aluminum in gates.

Ruff[14] actually measured the velocity of cast iron under foundry conditions. However, he used a downgate of large cross section with an ingate of small cross section. This probably resulted in higher velocities than would have been found if the ingate and downgate had been of the same cross section. He found velocities of about 7 ft./sec.

About 50 measurements were

made of the velocity of molten bronze flowing through gates of varying diameter, height and length. Other variables studied were the moisture content of the sand, pouring temperature and pouring time. The metals used for these experiments were gun metal, manganese bronze, and aluminum bronze. Several flat plates cast of these three metals under varying conditions of flow were examined for surface condition, and the mechanical properties were determined.

Melting Practice. High quality virgin metals and ingots of known composition were melted in clay-graphite crucibles in a 200-lb. capacity lift-coil induction furnace. Temperature was measured by means of bare wire chromel-alumel thermocouples with a standardized Leeds and Northrup millivoltmeter. This pyrometer had a time lag of about 5 sec. and was accurate to ±11° C. (±20° F.) at the pouring temperature of bronze. The melting procedures for the gun metal, manganese bronze and aluminum bronze are summarized in Table 1, and typical chemical compositions are given in Table 2.

Table 1

MELTING PRACTICE

	Gun Metal	*Manganese Bronze*	*Aluminum Bronze*
Crucible	Clay-Graphite	Clay-Graphite	Clay-Graphite
Furnace	High Frequency Induction	High Frequency Induction	High Frequency Induction
Melting Log:			
Copper	Melted under charcoal, deoxidized with 1 oz. 15% P-Cu/100 lb.	Melted under charcoal, deoxidized with 1 oz. of Al/100 lb.	Melted under charcoal, deoxidized with 1 oz. of Al/100 lb.
50-50 Fe-Al	—	2300° F (1260° C)	2300° F (1260° C)
50-50 Cu-Mn	—	2200° F (1200° C)	—
Sn	2060° F (1125° C)	2010° F (1100° C)	—
Al	—	—	2100° F (1150° C)
Zn	2010° F (1100° C)	2010° F (1100° C)	—
Pouring Temp.	2060° F (1125° C)	1800° F (980° C)	2010° F (1100° C)

Table 2

CHEMICAL COMPOSITIONS

Heat No.	Composition; per cent — *Cu*	*Sn*	*Zn*	*Al*	*Fe*	*Mn*
G25	87.53			9.24	3.01	
G23	87.84	8.14	3.98			
G24	87.26			9.71	3.03	
G32	57.92	0.60	39.06	0.86	1.00	0.56

Velocity Measurements. The data necessary for calculating the velocity were obtained by pouring a definite weight of metal through a specially designed mold in a known time. This mold was fitted with a pouring basin designed to maintain a constant liquid metal level, and was arranged so that the metal issuing from the ingate always fell below the lower level of the gating system in order to prevent back pressure (Fig. 2).

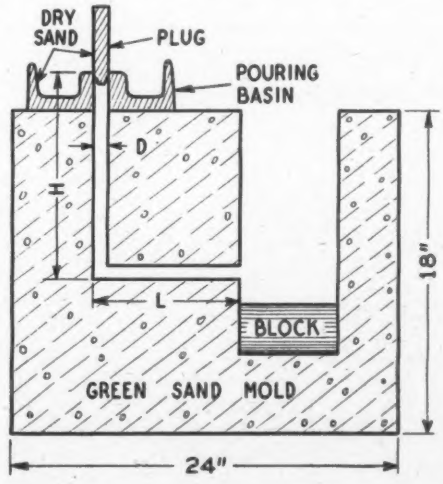
Molds were made of No. 2 Albany sand, and the pouring basins of dry core sand. The outlet from the pouring basin was of the same diameter as the gating system with which it was used.

Metal was poured into the side of the pouring basin until the metal level was ½-in. from the top, and was maintained at this level by constant pouring from the crucible for the duration of the test. The plug was removed from the opening in the basin when the desired metal level was reached, and as soon as metal began to issue from the gate a stop watch was started.

The metal was allowed to flow for about 10 sec. The plug was then replaced in the basin to prevent further flow; simultaneously, the watch was stopped. After the block of metal thus obtained had solidified, it was weighed and the volume velocity of the pouring calculated from the measured data; the volume velocity was then converted to linear velocity.

With the foregoing standardized procedures of melting and casting, the variables influencing the rate of flow were investigated, principally with gun metal. Emphasis was placed on geometrical factors such as the diameter (D), height (H) and length (L) of the gate (Fig. 2), because it was believed that these factors would have the most influence on velocity.

Other factors such as the moisture content of sand, pouring temperature, and pouring time were investigated primarily to determine their effect on the errors of measurement of the velocity. The velocity measurements with the various factors under investigation are listed in Table 3. Heats of manganese bronze and aluminum bronze were included



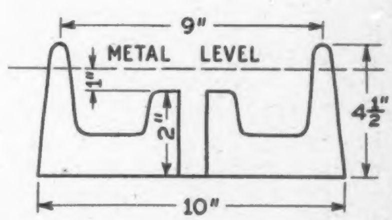


Fig. 2—Cross-sectional drawing of mold used to determine velocity of composition "G" metal through various gates.

Table 3

VELOCITY OF COMPOSITION "G" METAL IN GATES
(88% Cu, 9% Zn, 3% Sn)

Heat No.	Gate Diam., in.	Downgate Height, in.	Ingate Length, in.	Sand (% H_2O)	Pouring Temp., °C	Pouring Time, sec.	Velocity, ft./sec.
G-5	½	11	9	—	1125		2.84
G-5	½	11	6	—	1125		2.66
*	½	11	4	—	1125		2.90
G-14	½	8	9	9.0	1125		2.62
G-14	½	8	6	9.0	1125		2.66
G-6	½	8	4	—	1125		2.54
G-14	½	6	9	9.0	1125		2.58
G-14	½	6	6	9.0	1125		2.55
*	½	6	4	—	1125		2.42
*	¾	11	9	—	1125		2.33
*	¾	11	6	—	1125		2.05
*	¾	11	4	—	1125		1.58
G-15	¾	8	9	—	1125		2.25
G-15	¾	8	6	—	1125		1.58
*	¾	8	4	—	1125		1.45
G-10	¾	6	9	8.5	1125		2.32
G-10	¾	6	6	8.5	1125		2.14
*	¾	6	4	—	1125		2.04
G-16	1	11	9	—	1125		1.05
G-16	1	11	6	—	1125		1.32
*	1	11	4	—	1125		1.25
G-18	1	8	9	—	1125		1.38
G-18	1	8	6	—	1125		1.27
G-18	1	8	4	—	1125		1.37
G-19	1	6	9	—	1125		1.47
G-19	1	6	6	—	1125		1.47
*	1	6	4	—	1125		1.35
G-13	¾	8	4	6.3	1125		1.25
G-13	¾	8	4	8.5	1125		1.19
G-13	¾	8	4	10.0	1125		1.39
G-13	¾	8	4	12.0	1125		1.27
G-7	½	11	4	—	1135		3.10
G-7	½	11	4	—	1120		2.86
G-7	½	11	4	—	1105		3.10
G-7	½	11	4	—	1075		2.87
G-31**	½	8	4	—	1125		2.70
G-32†	½	8	4	—	980		2.62
G-40	½	8	4	—	1125	5.5	2.77
G-40	½	8	4	—	1125	8.9	2.88
G-40	½	8	4	—	1125	18.2	2.84
G-36	½	11	4	—	1315		2.27
G-36	½	11	4	—	1215		2.11
G-36	½	11	4	—	1150		2.16
G-36	½	11	4	—	1035		2.28

*Average of several heats
**Aluminum Bronze
†Manganese Bronze

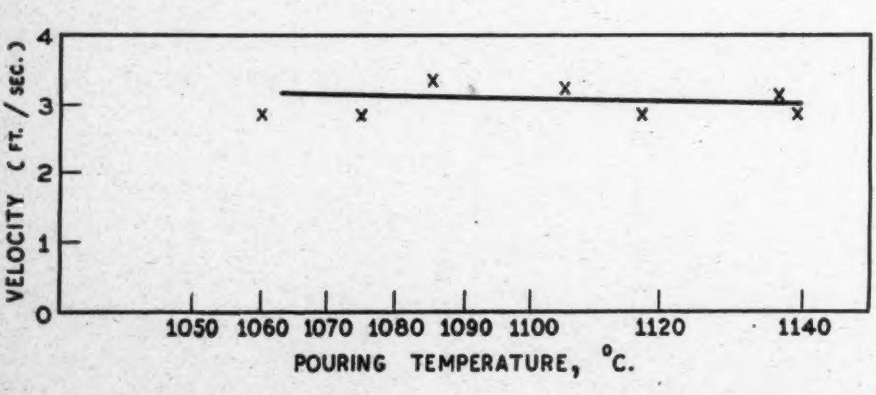


Fig. 3—Chart showing velocity of composition "G" metal vs. pouring temperature (11x½-in. downgate, 4x½-in. ingate).

for comparison with the gun metal.

Mold Design. The design of the mold was given careful consideration and that shown in Fig. 2 was chosen because it fulfilled the following conditions:

a. Permitted variations in the height, length, and diameter of gates.

b. Prevented back pressure from metal in the mold from acting on the metal in the gate.

c. Utilized a pouring basin that provided a constant liquid level, and a means for starting and stopping flow of metal into the gating system.

d. Provided a means of measuring the volume velocity (cu. in. per sec.) from which the linear velocity (ft. per sec.) could be calculated.

e. Allowed comparisons to be made between measured velocities and those calculated by means of the formula $V = K\sqrt{2gh}$.

Velocity Measurements. The velocity of composition "G" flowing through the gating system was but little affected by changes in pouring temperature, pouring time, or the water content of the sand (Table 3 and Fig. 3). Varying the downgate and ingate lengths from 4 to 11 in. had a negligible effect on the velocity of composition "G" (Figs. 4 and 5). Increasing the gate diameter from ½-in. to one in. decreased the linear velocity from 2.5 ft. per sec. to 1.3 ft. per sec. (Fig. 6).

Downgate Affects Velocity

The fact that the height of downgate had a negligible effect on the velocity was unexpected, and contrary to common theories and experiences with respect to fluids flowing through pipes under the influence of gravity. Equations for the flow of liquid through an orifice in the bottom of a large reservoir show that:

$$\text{linear velocity} = K\sqrt{2gh}$$

$g = 32$ ft. sec.^{2} (acceleration due to gravity)
h = height of the pipe in ft.
k = a constant.

Many formulas for predicting the rate of metal flow through gates are based on this equation [10, 13, 16]. It was believed that one reason for the negligible effect of height of downgate on velocity was that the liquid metal was running through a channel having permeable walls, i.e., a sand mold, whereas the conditions

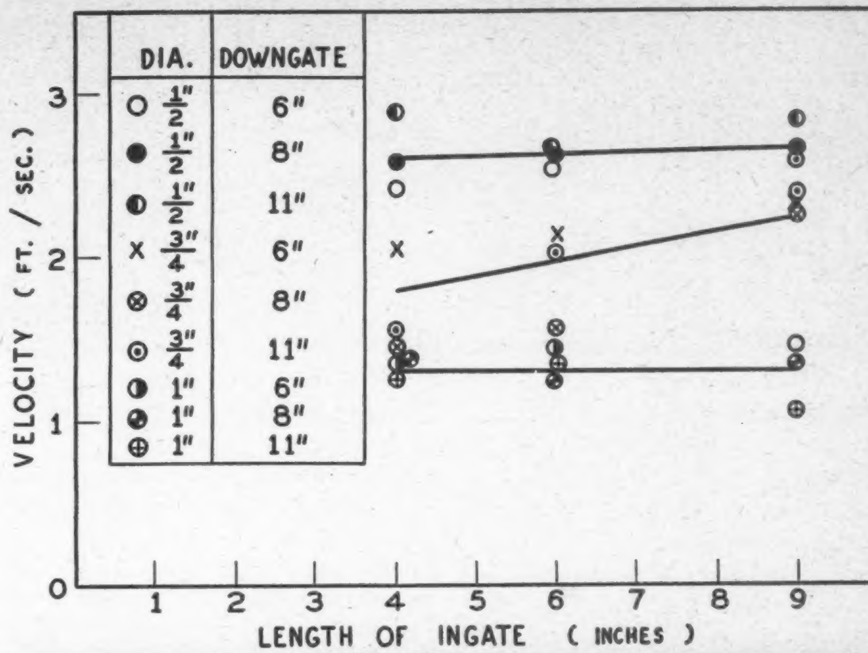
of the velocity equation assume a fluid running through a channel with impermeable walls.

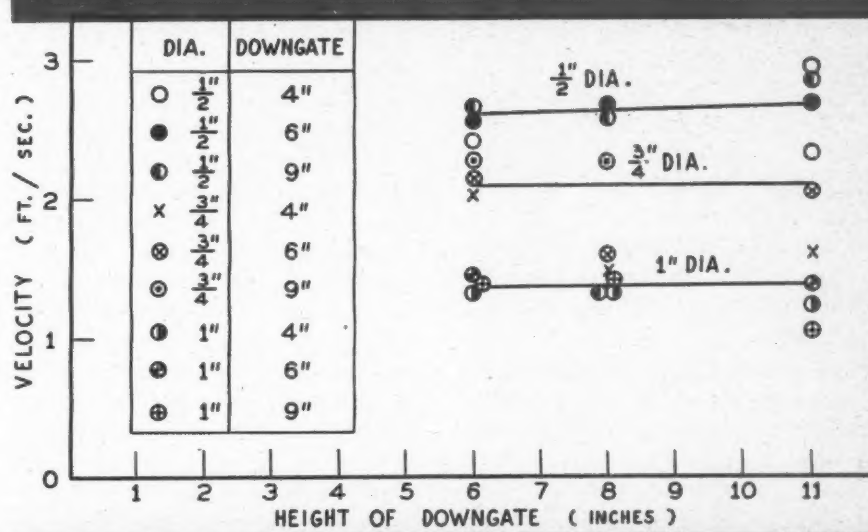
Varying the gate diameter had the most pronounced effect of any of the variables studied, the larger diameters resulting in lower linear velocities (Fig. 6). From consideration of the friction involved and the surface to volume ratios of large and small gates, the opposite effect might have been expected had the dimensions of the downgate itself been the controlling factor.

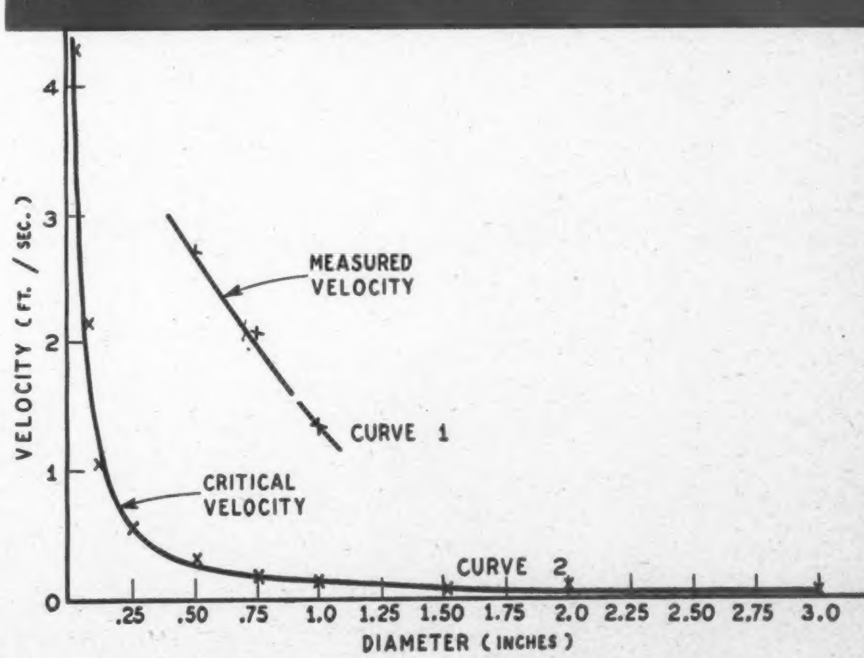
Experimental Errors. In general, control of the variables mentioned did not result in velocity changes greater than the experimental error. One source of error was variation in the height of the metal in the pouring basin. An effort was made to maintain the level at one in. above the top of the downgate. This level varied about ¼-in. Another source of error was the time measurement. An error of about ½-sec. may have been made in timing the insertion of the plug to stop the flow of metal.

Turbulence of Flow. The Reynolds' number has been taken as a criterion of turbulence, as previously explained. With the aid of this expression and with a Reynolds' number of 2,000, the critical velocity of bronze has been calculated and is shown in Fig. 6 by curve 2. This is the limiting velocity for a given diameter of pipe, above which velocity turbulence gradually sets in with any increase in velocity.

On the same graph, the actual or measured velocities are shown for various diameters of gate. The Reynolds' numbers for the actual conditions, with the respective gate diameters, are approximately ten times the Reynolds' number for the critical velocity of flow. This means that the measured velocities were nearly ten times higher than the ve-







Reading from top to bottom:
Fig. 4—Velocity of composition "G" metal vs. length of ingate.
Fig. 5—Velocity of composition "G" metal vs. height of downgate.
Fig. 6—Velocity of composition "G" metal vs. diameter of gate.

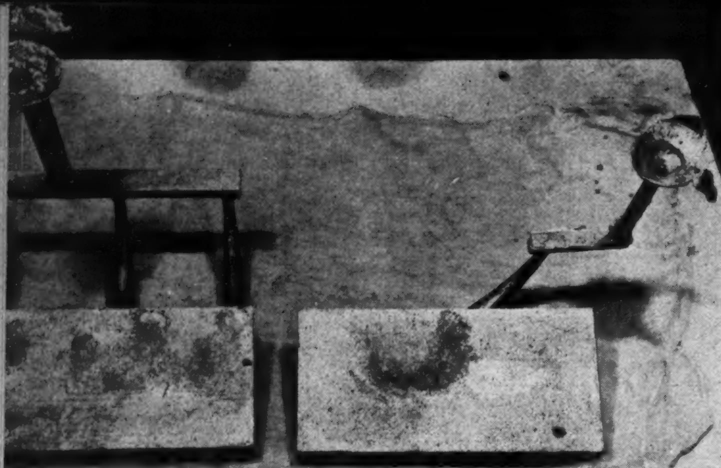


Fig. 7—Flat plates cast with gating systems employing "reversed" horn gates.

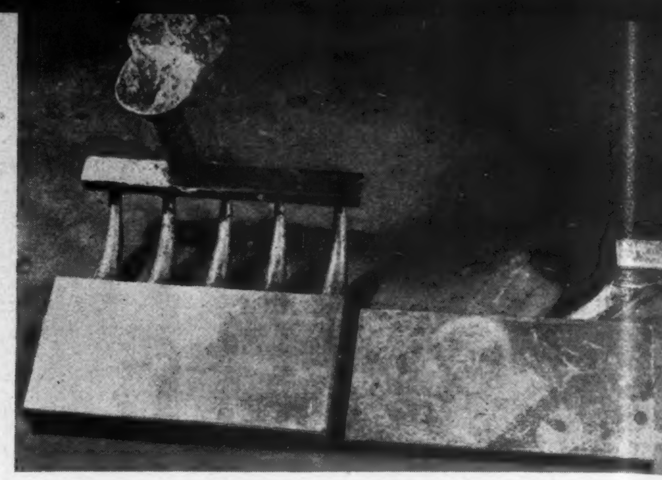


Fig. 8—Gating systems employing "reversed" and "regular" horn gates.

locities on the borderline of streamline and turbulent flow.

If curve 1 is extrapolated to curve 2, it is found that streamline flow theoretically should be obtained with gate diameters of approximately 1/16 or 1½ in. and proper velocities of flow, but these conditions obviously are impractical for foundry operation. The second part of this investigation concerns the practical significance of velocity of flow and its control by well-known methods of gating.

Practical Use of Controlled Velocity of Pouring

The velocity measurements described in the preceding section made it possible to predict the linear velocity of the three alloys flowing through the type of gate system used in this investigation (Fig. 2). Calculations of the Reynolds' numbers of these systems showed that the metal always was flowing in a turbulent manner.

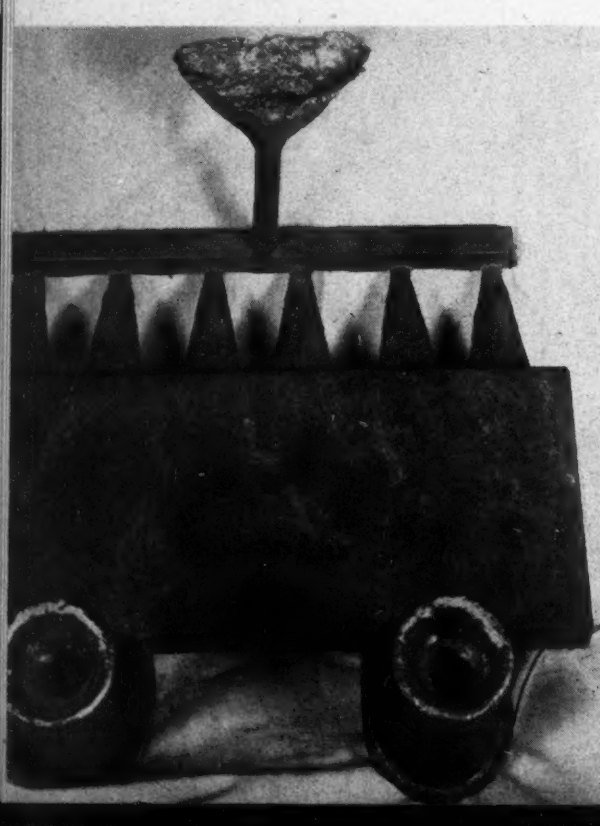
Procedure. The effect of pouring under streamline and turbulent conditions on the dross-forming characteristics was then investigated with aluminum bronze, manganese bronze, and gun metal. Several 1x6x12-in. flat plates were cast with gating systems employing one, three, and five "reversed" horn gates and one "regular" horn gate (Figs. 7 and 8). These systems included various combinations of exit diameter and metal velocity, which resulted in a wide range of Reynolds' numbers.

Additional plates were then cast using a series of thin, flat, tapered gates which were expected to have the same dross-prevention properties as the five horn-gate systems without the inherent disadvantages of horn gates (Figs. 9 and 10). The plates were examined for surface defects and photographed (Figs. 7, 8, and 9). Tensile specimens were cut from the centers of the plates to show the effect of dross on mechanical properties (Table 4).

As shown in Figs. 7, 8, and 9, the surface of the casting gives an indication of the drossiness of the metal. Highly dross-forming alloys such as aluminum bronze show more dross on the surface of the casting when the pouring is more turbulent. The difference in the appearance of the surface of aluminum bronze in Fig. 7 is easily recognized when the turbulence of the metal was increased by using one horn gate in place of three horn gates.

Gun Metal Different

The situation is entirely different with gun metal because this is not a dross-forming alloy. As shown in Fig. 8, the velocity of pouring makes little difference in the surface of the casting of this metal. Even



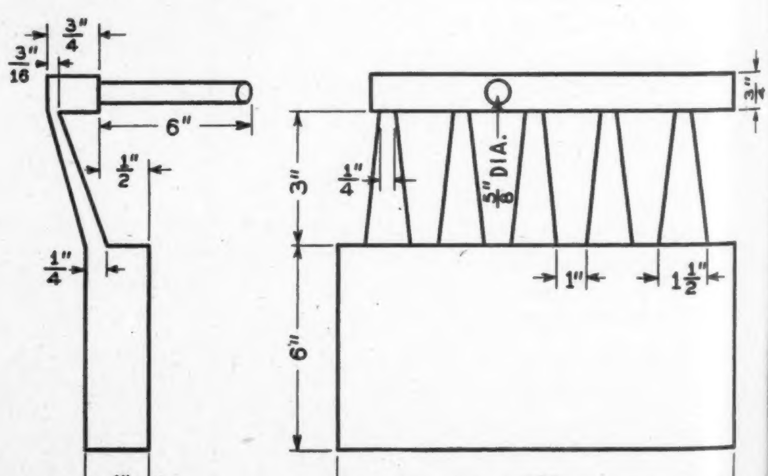


Fig. 9 (left)—Flat plate cast with thin, flat, tapered gate.

Fig. 10 (above)—Sketch of gating system employed in casting flat plate (Fig. 9).

when the metal was sprayed into the mold cavity through the single horn gate (small diameter adjacent to the casting) no dross occurred on the surface of the casting.

The use of multiple horn gates to reduce the rate of metal entry into the mold cavity has many obvious disadvantages. This method was used only as a means to investigate the effect of rate of flow. It was found both empirically and by calculation for streamline flow that the product of the number of horn gates and their largest diameter (adjacent to casting) must be ten times the diameter of the downgate.

Aluminum Bronze

When this condition is satisfied, dross-free aluminum bronze may be poured with no dross formation on the surface of the casting. Fluted ingates of elliptical cross section may be used as shown on the aluminum bronze plate in Fig. 9 in order to produce a practically clear surface. The important part of the gating system is the point at which the metal enters the mold. At this point the flow of metal should be streamline for the best quality of castings.

Apparently, the turbulence at the constriction of the fluted ingate has little effect provided that the combined cross-sectional area is smaller than the cross-sectional area of the downgate and will permit the downgate to remain full when the metal is poured. The use of fluted ingates of elliptical cross section designed according to principles of fluid flow was believed to afford the most practical means for obtaining streamline flow of dross-forming alloys.

Tensile specimens taken from the aluminum-bronze plates showed wide variations in mechanical properties (Table 4). The plate cast under predicted streamline-flow conditions had uniformly high properties, while the other plates showed decreasing properties as well as an increasing scatter of results. Examination of the fractures of faulty test bars showed the presence of oxide inclusions which were produced from the turbulent flow of the metal.

Table 4

MECHANICAL PROPERTIES OF PLATES CAST WITH METAL POURED INTO VARIED GATING SYSTEMS

Heat No.	*Horn Gates, no.* *Regular*	*Reversed*	*Ingate Diam.xN / Downgate Diam.*	*Yield Strength, psi.**	*Tensile Strength, psi.*	*Elongation, % in 2 in.*
G 25-1	1		0.02	8,500	37,500	6
G 25-1A	1		0.03	27,750	70,000	16
G 25-1R		1	2.6	26,500	82,000	35
G 25-1RA		1	2.6	25,000	51,000	2
G 25-3R		3	4.0	24,000	70,500	19
G 25-3RA		3	4.0	25,000	78,000	26
G 25-5R		5	6.0	27,250	82,000	38
G 25-5RA		5	6.0	27,750	81,750	33
G 23-1	1		0.03	13,750	29,050	16
G 23-1A	1		0.03	11,500	18,550	1
G 23-5R		5	6.0	11,000	15,550	2
G 23-5RA		5	6.0	13,750	28,000	11
G 34-1R		1	2.6	23,750	50,000	3
G 34-1RA		1	2.6	27,500	73,000	7
G 34-3R		3	4.0	26,250	81,500	18
G 34-3RA		3	4.0	25,625	81,500	19
G 34-5R		5	6.0	25,625	65,000	14
G 34-5RA		5	6.0	26,000	66,000	10

*0.5% offset

Summary

a. Height of downgate and length of ingate appear to have little effect on the linear velocity of bronze in a gate of uniform cross section.

b. Aluminum bronze and manganese bronze form dross when poured under turbulent conditions, but are dross-free when streamline flow is attained.

c. Gun metal is less susceptible to dross formation than aluminum bronze or manganese bronze.

d. Turbulence is decreased by making the diameter of the gate at the junction of the gate and the casting greater than the diameter of the downgate.

e. Turbulence is reduced by using one or more tapered ingates, having the large end against the casting, and the total area of the small ends slightly less than the area of the downgate.

f. Plates of aluminum bronze cast with turbulent flow have mechanical properties inferior to those cast under streamline conditions.

g. Thin, flat, tapered ingates help promote directional solidification in aluminum bronze and manganese bronze.

The results obtained in this investigation and those reported elsewhere in the literature indicate that the following gating techniques are fundamentally sound:

A. For drossy metals (aluminum bronze, manganese bronze)

1. Use bottom gates wherever possible.

2. Take precautions in the use of horn gates so that the section size of the horn gate will not be large compared to the section size of the gated portion of the casting.

3. Gate thin sections by using thin, flat, tapered gates which impart all the advantages of horn gating without its harmful effect on feeding.

4. Keep the gating system full at all times. In a full gate dross will be retained by adhering to the point where it is formed. Care must be taken to avoid pouring dross into the gate from the crucible. If the gate is kept full, and no dross is added from the crucible, the use of dross sumps may be eliminated.

5. Use pouring basins where possible. These should be so designed that the metal is not poured directly into the downgate from the crucible but into a reservoir offset from the gate.

B. For nondrossy metals (tin bronze)

1. Direct riser pouring is permissible provided that care is taken to avoid excessive splashing or cutting of the sand.

C. General Recommendations

1. "Various portions of the casting should be so arranged that they are connected with a rising channel of increasing cross section."[5]

2. Gates should be placed to promote directional solidification and should be easy to remove.

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DISCUSSION

Chairman: D. FRANK O'CONNOR, American Saw Mill Machinery Co., Hackettstown, N. J.

Co-Chairman: HERMAN SMITH, Federated Metals Div., American Smelting & Refining Co., Pittsburgh.

MEMBER: For the benefit of those who might want to apply this data to practical problems in designing gates, the author spoke of the viscosity of molten metal in Reynolds' number. Would you assume it is constant for the various types of brasses and bronzes or could that be determined?

MR. HARDY: Some work has been done on the determination of viscosities of metals, but the high temperatures involved make precise measurement difficult. The *International Critical Tables*[15] list viscosities of several bronzes at several temperatures and these are all of the same order of magnitude. Possible ways to measure viscosity include measurement of the torque exerted upon a cylinder placed in a rotating crucible of metal, or measuring the damping effect on a pendulum swinging through a bath of metal. Clark, in his 1946 Exchange Paper with the IBF of England, lists a very good bibliography of various methods that have been tried. (See AMERICAN FOUNDRYMAN, July, 1946, p. 44.)

E. J. DUNN:[1] It is my understanding from what the author said that as you increase the diameter, the linear speed decreases. Now with constant heat and a constant source of metal such as you had, will you give an explanation of that? I had expected it to increase.

MR. HARDY: This puzzled us at first. We think that this anomolous result was due to the shape of the pouring basin, Fig. 2. We attempted to maintain one inch of metal above the gate. This was easily done with small diameter gates, but on larger diameter gates, at times a vortex formed over the down-gate so that the depth of metal there was less than one inch, so there was less pressure there to force the metal through the gate. I think that if we had used a deeper pouring basin this might not have happened.

MR. DUNN: Would you expect an increase then?

MR. HARDY: We expected an increase in linear velocity with large diameter gates, because for a given volume and weight of metal there is less surface on a large diameter. Therefore, there should be relatively less friction on large diameter gates. However, we found the reverse to be true.

GEORGE DALBEY:[2] I would like to ask if the Reynolds' number will be included in the final printing of the paper?

MR. HARDY: Most textbooks on hydraulics show how to use Reynolds' number. Walker, Lewis, McAdams and Gilliland[17] in the references at the end of this paper describe its use.

[1]Chase Brass & Copper Co., Cleveland.

[2]U. S. Navy Yard, Mare Island, Calif.

MAGNESIUM GROUP
Features Light Metal's World Status

THE MAGNESIUM ASSOCIATION, holding its third annual meeting at the Waldorf-Astoria Hotel, New York, October 3-4, named R. D. Taylor, Federated Metals Div., American Smelting & Refining Co., New York, president for 1946-47; J. D. Barrington, Dominion Magnesium, Ltd., Toronto, vice-president, and I. T. Bennett, Revere Copper & Brass, Inc., Baltimore, Md., treasurer. T. W. Atkins continues as executive vice-president and secretary.

Registered delegates to the meeting totaled 316, twice the number attending last year, and the opening phase of activities was the First International Magnesium Congress, Thursday morning. Addressing this session were:

Major C. J. P. Ball, D.S.O., M.C., Magnesium Elektron, Ltd., London; R. J. Cross, Essex Aero, Ltd., Gravesend, Kent, England, and A. H. Waterfield, Aircraft Materials Research and Development Branch, Ministry of Supply, London.

Other representatives of out-of-the-country interest in the proceedings were present at the luncheon Thursday, and included: Lord Pentland, representing the British Consul-General; E. A. Pernet, Vice Consul for Switzerland; Honorable Hugh Scully, Consul-General for Canada, and Willy Van Cauwenberg, Vice Consul for Belgium.

Business session of the meeting took place on Thursday afternoon. Presenting committee reports were: development committee, E. W. Rouse, Revere Copper & Brass, Inc., New York; standards committee, A. W. Winston, The Dow Chemical Co., Midland, Mich.; traffic committee, J. L. Briggs, Revere Copper & Brass, Inc.; educational committee, A. M. Lennie, The Dow Chemical Co., and technical committee, Anthony Cristello, Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J. The treasurer's report given by C. E. Larson, White Metal Rolling & Stamping Corp., Brooklyn, N. Y.; and the annual address of the president by E. S. Christiansen.

The association named as its directors for the coming year: J. D. Barrington; I. T. Bennett; Arthur Bidwell, Superior Bearing Bronze Co., Brooklyn; Wiser Brown, American Magnesium Corp., Cleveland; E. S. Christiansen; Anthony Cristello; L. B. Grant, Magnesium Div., The Dow Chemical Co.; Fred Hengsch, Castalloy Co., Inc., Cambridge, Mass.; C. E. Larson; D. W. Moll, Hills-McCanna Co., Chicago; G. W. Motherwell, Wyman-Gordon Co., Worcester, Mass.; W. H. Osborne, Acme Aluminum Foundry Co., Chicago; E. H. Perkins, Brooks & Perkins, Detroit; D. A. Rhoades, Permanente Metals Corp., Oakland, Calif.; V. D. Sweeney, National Smelting Co., Cleveland; R. D. Taylor; and D. G. White, White Aircraft Corp., Palmer, Mass.

RAMMED REFRACTORIES

ELECTRIC FURNACES

Robert H. Zoller
Zoller Castings Co.
Bettsville, Ohio

BRICK AND MONOLITHIC refractories in steel melting are familiar subjects among foundrymen. The aptitude of brick or monolithic lining to the job is of prime importance to the operator and the overall foundry operation.

Selection of the proper type of refractory should correct refractory problems and cut operating costs. Of course, no one refractory can be made to completely correct all problems, but the job can be studied and the right type of refractory applied to that job. The thought must be that an improved refractory can be developed for any job. Use of a refractory should be discontinued when it is known to be giving poor service and hindering production.

Monolithic Linings

Brick refractory used today in electric furnaces or ladles may be replaced in almost all cases with monolithic linings. However, brick cannot be replaced by rammed linings in cases of arches or suspended sections where the refractory must support its own weight. Some work has been done on the development of a refractory mixture for ramming furnace roofs.

In electric furnaces, where high temperatures are encountered, silica brick are used. Silica brick have been used for many years, and with sufficient care can be prepared for service without spalling or cracking. However, time for heating is required or deficiency in the brick will be encountered. Temperature change is not responsible for all unsatisfactory performances of refractory brick. A silica brick, within reason, has the same expansion as the brick next to it.

Expansion

However, laying of the brick may not at all times be such that expansion will be the same in all directions. The principle reasons for this are: (1) the first row of bricks not started correctly; (2) bricks not of true size. The first reason can be corrected by sufficient care and training. In many cases furnaces have metal penetration in brick seams, entailing much extra work for preparation of a level footing for the first course. As to brick sizes, refractory manufacturers have made much progress toward producing brick of uniform size.

A picture of the electric furnace lining has now been presented. Difficulties due to expansions, brick joints or seams, and leveling of bottom of side wall can be eliminated by using a rammed refractory. A clean, irregular surface is all that is required for the foundation of a side wall of a monolithic-lined furnace. For good practice, only a liquid bonding agent is required on this surface.

If for some reason a lining is becoming thin in a section, due to burning of the arc or from corrosion, the side wall can be increased in thickness at this section. A furnace might, under certain conditions, require only partial relining. This repair job would not be at all difficult as no leveling is required.

After the section has been thoroughly cleaned and washed with a liquid bond or a dry bond mixed with water to make a wash, the refractory is rammed into place. If the surface of old refractory has been properly cleaned and bonded, metal penetration will not occur. The expansion will be the same in all directions, and proper density obtained with skilled ramming.

Ramming Mixture Coarseness

Rammed electric furnace bottoms are successful if a proper refractory mixture is worked out for the job. It has been found that ramming mixtures should have a high per cent of coarseness, and it is the author's opinion that coarseness should be increased almost to the point of causing trouble in the ramming operation. This gives greater fusion depth and, if a high-temperature ganister is used, it will also raise the fusion temperature of the complete ramming mixture.

It must be remembered that proper skill should be exercised in all ramming operations. A bottom

Selecting a refractory for the job; developing routine methods for refractory installation and preparing the unit for service; drying and preheating are important factors in lengthening refractory life and decreasing foundry operating costs.

Presented at a Refractories Session of the Fiftieth Annual Meeting, American Foundrymen's Association, at Cleveland, May 7, 1946.

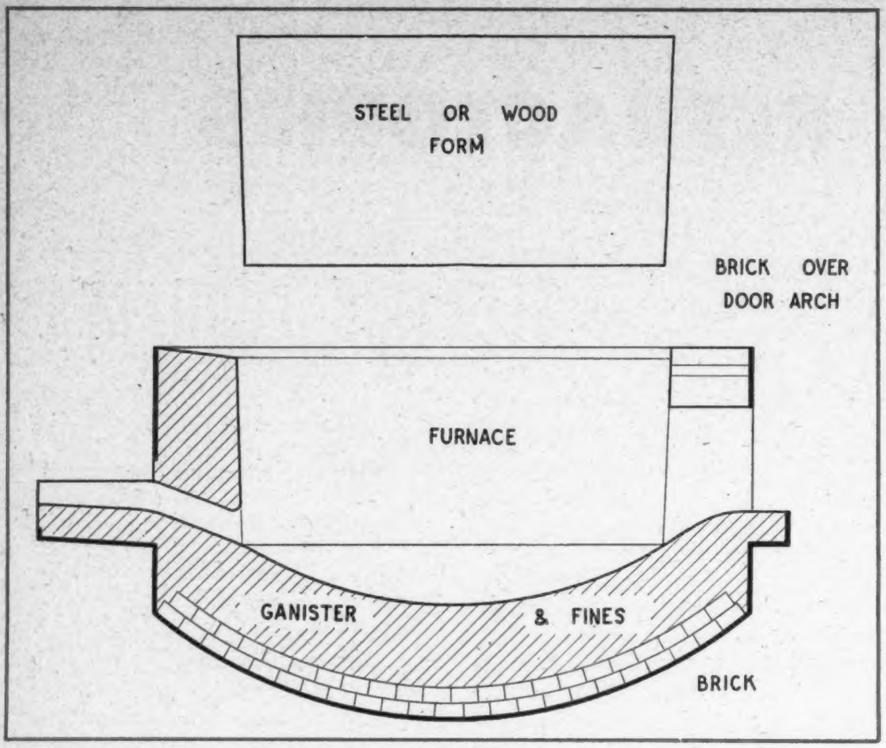


Fig. 1—Method of form construction for furnace side wall rammed refractory.

should have as great a density as possible. The density obtained by a good ramming job will be cushioned and bound by the high percentage of coarseness in the refractory mixture, as the coarse material has less expansion than the fines. Upon heating to high temperatures, this cushion and binding are definitely needed or sections will break loose, thus taking away refractory life from the rammed unit.

Ladles of different sizes can be lined with the same mixture or one similar to that used in the electric furnace side wall. Usually, it will be found that standardizing refractory mixtures will be of great assistance in keeping them consistent. In some small ladles with refractory bridges, trouble may be encountered and the ramming mixture might have to be changed accordingly.

Refractory Heating

Development of a highly bonded refractory, or one with a degree of plasticity well under top fusion temperature will not solve this problem, as slagging of the refractory will be encountered. Proper heating of the refractory is important and will be discussed in a later paragraph.

In refractory selection, the versatility of the monolithic refractory and its aptitude for the job should be considered. In most cases, special shapes or cutting of bricks are out of the question. Forms are made for the furnace side wall, as shown in Fig. 1, and for a teapot ladle, as shown in Fig. 2. The forms are constructed to give the contour desired in a unit.

Ramming Operation

In many cases, for convenience, the form may be made in sections, either loose or joined together for adjustments in the ramming operation. In extreme cases, where certain sections of a furnace or ladle may require a patch, the form may be adjusted, blocked or wedged in such a manner that a new portion can be rammed in any part of the unit.

In working out a good refractory for steel furnaces and ladles, three main points should be considered: fusion temperature and sintering range, fines or coarseness, and density of the ram. These points should be studied carefully. In steel furnaces, a refractory with a high fusion temperature is desired. It is not at all a simple matter to properly bond together a refractory mixture with a high fusion temperature.

It is definitely desirable to use a good grade of high-temperature ganister in the mixture. If advisable, a sized and washed ganister may be employed at no additional cost as compared with a good grade of ganister. Here is found a definite reason for improvement because of the certainty that a consistent amount of coarseness or fines is added to the mixtures.

This point cannot be minimized because it is important to use the high-temperature ganister in as great proportion as possible in the refractory mixture. Consequently, if properly studied and applied, both fusion temperature and coarseness or fines may be used to their greatest advantage.

Coarseness Proportions

However, it is not advisable to use the high proportions of coarseness in a refractory mixture for a furnace side wall or ladle as that used in a furnace bottom. The reason for this is that a side wall cannot be properly bonded for heating. The third point, density of ramming, is obtained by proper proportions of fines and skill in ramming.

Here again proper proportions of of coarseness and fines play an important part. A consistent result necessitates: (1) a consistent refractory mixture; (2) the ramming or handling of that refractory mixture should be the same at all times.

A furnace or ladle should always have a refractory drying period to

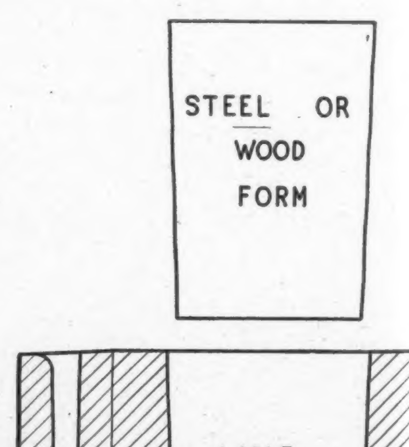


Fig. 2—Form construction for teapot ladle rammed refractory.

obtain good results. This fact is admitted in most cases, but few ladle departments have done much about it. Ladles may be put into operation with only partial drying of the refractory and fair results obtained when operating a makeshift set-up.

Properly Dried Ladles

If an insufficient dried ladle is put into service holding high-temperature steel continuously during 24-hr. days, it has been proved that the results will not be satisfactory. Usually, records will show 75 per cent, or less, of the efficiency realized from a properly dried ladle. The time required for drying ladles is about 2 to 3 hr. per in. if dried in an oven at 350° F. The moisture added for the bonding qualities and ramming is definitely undesirable after the ramming and should be totally eliminated, except for the low percentage of combined water in the mixture, before the unit is heated for use.

Furnace and ladle shells can be easily prepared for drying. Small ladles, such as one-man shank ladles of 1 or 1½ in. refractory thickness, need only an oven dry. The furnace and larger ladle shells should be prepared by drilling or burning ⅜-in. holes on 12 to 18-in. centers. This will allow the moisture to escape freely in all directions.

With the proper drying of a ¼-ton ladle with skimming bridges, and pouring continuously, it was found that with continuous pouring a 15-ton average could be maintained through these ladles, as compared to the 3 to 5-ton average obtained with improperly dried and heated ladles.

With reference to ladle drying time, the author wishes to emphasize that this time period is from the time ramming is completed to the time the ladle is to receive metal. The ladle is properly dried, then heated to temperature for the molten steel by the ladle cover and heater shown in Fig. 3 (for large ladles), and in this heating the refractory should remain intact.

Spalling or breaking away of sections may be caused by applying heat too drastically or by a direct flame against a portion of the refractory itself. The heating of any ladle is of prime importance and cannot be taken lightly. If the refractory is too low in bonding, which it will be for steel, in most cases, it will be necessary to add a liquid bond to the surface. This will penetrate into the refractory about one in. and will hold the refractory from spalling through this period. Many liquid bonds on the market will answer the purpose.

Proportions of the ingredients should be consistent at all times if the refractory is to be kept at high efficiency. The work area of the refractory department can be so arranged that all work can be standardized for the mixing operation. Bins for the ingredients, with proper measuring tools, should be arranged conveniently. Measuring cans should be provided for the moisture or any liquid bond that might be added.

Moisture, coarseness, fines, and bond can be added accurately. It is always a good practice to place all dry ingredients in the mixer and mix thoroughly in the dry state before adding moisture. Usually, a ramming mixture will be satisfactory for ramming if the moisture is held at between 5 and 6 per cent. However, to obtain maximum ramming qualities in some refractory mixtures may necessitate varying the moisture content out of this range.

Dry Refractory

Drying and heating for use of the electric furnace does not require any great skill, but a furnace should definitely have a dry refractory before starting. The bottom can be burned in slowly with coke after an overnight or its equivalent period for predrying with burners or wood. This is a simple operation. The furnace is completely lined, with roof and electrodes in place.

A large wheelbarrow of coke for each ton of furnace melting capacity is leveled off over the bottom of the furnace. The electrodes are then lowered to the coke with power on and rheostats adjusted to low fire, with low tap. A short period of fire will induce the coke to burn in the center. At short intervals of firing, the furnace may be either dried out further while being heated for use or, if desired, the roof and side walls may be glaze fired.

For many who have not used coke for this purpose, it is interesting to know that coke will make exceptionally good contact and can be heated to a white heat if desired. If the bottom is to be fused on the surface, electrodes may be placed as a letter "T," making a contact between the three electrodes. Then high-tap firing at intervals will fuse the surface, as the arc may be directed in any direction. In a bottom-fusing operation, the furnace must be preheated to a red heat.

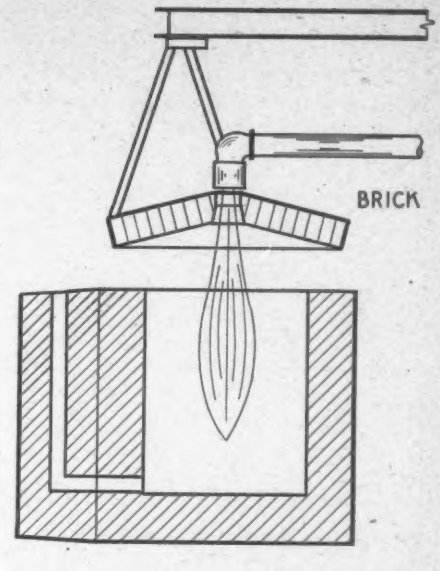


Fig. 3—Ladle cover and heater.

If the side wall is also rammed, it should be dried before heating with coke, but need not be heated to a red heat such as recommended for fusing bottoms.

Standardization of refractory mixtures and maintaining routine practices have always been necessary in making a good refractory mixture. The importance of methods set up in the refractory department, and care of the refractory in the unit being repaired or rebuilt, cannot be minimized.

A method which may work in one plant, of course, does not always work to a good advantage in another plant, but that is no reason for condemning the refractory. Different operation necessitates different handling of metal; consequently, the same results may not be realized and the refractory must be changed or altered for the operation in which it is to be used.

DISCUSSION

Chairman: C. E. Bales, Ironton Fire Brick Co., Ironton, Ohio.

Co-Chairman: C. S. Reed, Chicago Retort & Fire Brick Co., Chicago.

Co-Chairman Reed: What type of mixing equipment do you recommend?

Mr. Zoller: I have seen a concrete mixer, regular mullers, and high speed mullers used. One refractory ladle lining mix that was used had a life of 54-5/10 heats per ladle. That is continuous pour-

ing of manganese steel castings 24 hours a day. This lining was mixed in a cement mixer. A high speed muller was then used and the lining life was increased to 85 and some tenths heats per ladle. Then we took the same high speed muller and by adding 35 per cent coarse material of 1/8 to 1/4-in. high-fusion washed ganister to the mix; increased the lining life to 109 heats.

CHAIRMAN BALES: Mr. Briggs of the Steel Founders' Society, did you observe any foundries where ramming refractories were in use when you were in Germany a short time ago?

C. W. BRIGGS[1]: Yes, I saw many furnaces rammed with monolithic linings. However, nearly all the furnaces were basic lined. The few electric furnaces using an acid lining were lined with silica brick.

I should like to make the following comments concerning the paper by Mr. Zoller. Rammed silicious linings for acid electric furnaces have been used for a number of years in a fashion similar to that described by the author. It was regretable that Mr. Zoller could not have added to this information by detailing the procedure employed, such as; the time of mixing, the type and quantity of bond materials, sizing classification, moisture content, etc., instead of continually referring to the proper mixing, the proper degree of coarseness, and to other proper conditions.

[1]Technical and Research Director, Steel Founders' Society, Cleveland.

EIGHTH DIVISION

Of A.F.A. Formed by Education Groups

PERSONNEL TRAINING COMMITTEES of A.F.A. assumed a new status—equal to that of other major groups of the Association—when they were organized as its eighth technical division, the A.F.A. Educational Division, at a joint meeting of all committee members at the Congress Hotel, Chicago, October 18.

F. G. Sefing, International Nickel Co., New York, was elected Division Chairman; A. W. Gregg, Whiting Corp., Harvey, Ill., Division Vice-Chairman; and H. F. Scobie, A.F.A. National Office, Division Secretary.

Division Members

Other members of the division Executive Committee are: Frank Cech, Cleveland Trade School, Cleveland, Chairman, *Industrial Training Committee;* B. D. Claffey, General Malleable Corp., Waukesha, Wis., Chairman, *Youth Encouragement Committee;* Prof. P. E. Kyle, Cornell University, Ithaca, N. Y., Chairman, *Engineering Schools Committee;* and W. G. Gude, Penton Publishing Co., Cleveland, member-at-large.

A. W. Gregg will serve as Chairman, *Program and Papers Committee.*

The joint meeting of all committee personnel gave those present an opportunity to obtain a clear picture of the structure of the Division and an understanding of the purpose and activities of its committees. Subcommittees of the main groups are:

For the Industrial Training Committee, *Apprentice Training,* of which Prof. W. H. Ruten, Polytechnic Institute of Brooklyn, is Chairman; *Apprentice Contest,* Chairman to be announced in the near future; and *Foreman Training,* Chairman, S. G. Garry, Caterpillar Tractor Co., Peoria, Ill.

For the Engineering Schools Committee, *Research Projects,* Chairman, C. O. Burgess, Union Carbide & Carbon, Niagara Falls, N. Y.; *In-Plant Training,* Chairman to be announced; *Foundry Courses,* Chairman to be announced; *Recruiting of Engineers,* with Prof. G. J. Barker, University of Wisconsin, Madison, as Chairman.

College Lectures

National Director G. K. Dreher, Rogers Pattern & Foundry Co., Los Angeles, serves as Chairman, *Foundry Talks Subcommittee* and as Vice-Chairman of the *Engineering Schools Committee.* The former group is preparing a number of talks suitable for presentation before college engineering students.

In a discussion of the Educational Division program for the 1947 Convention, to be held in Detroit, April 28-May 1, the members agreed upon a tentative theme for the joint sessions: "Management's Responsibility in Personnel Training."

It was also agreed that one technical session should consist of papers on phases of personnel training; apprentice training, foreman training and training for engineering school graduates. The Program and Papers Committee, Chairman A. W. Gregg indicated, will report soon on the speakers for the meetings.

Name Detroit Directors

TWO CHAPTER DIRECTORS have been named by Detroit A.F.A. chapter to fill unexpired terms. R. J. Wilcox, Michigan Steel Casting Co., replaces Ernest Lancashire, Detroit Steel Casting Co.; and J. E. Coon, Packard Motor Car Co., serves out the term of E. J. Burke, Hanna Furnace Corp. All are of Detroit.

Sand for the foundry: left, taking on a truckload at the pit, and, right, delivering the truckload at the plant for processing.

(Photos courtesy C. A. Chier Sand Co. and Barber-Greene Co.)

FOUNDRYMEN HAIL
Second Maritime Regional Conference

A TECHNICAL PROGRAM based on the requirements of local foundrymen was warmly received at the second annual Maritime Regional Foundry Conference, sponsored by Eastern Canada and Newfoundland A.F.A. chapter on September 27-28, at the Charlottetown Hotel, Charlottetown, Prince Edward Island.

Ontario and Quebec foundrymen came up from Montreal for the lectures and group meetings, and twice the number registered from the Maritimes, to swell attendance for the sessions and assure the complete success of the undertaking.

General chairman for the conference was W. J. Brown, Robert W. Bartram Co. Ltd., Montreal, and a Director of Eastern Canada and Newfoundland chapter. Friday morning, September 27, was devoted to registration, after which, at the informal luncheon, Chapter Chairman Henri Louette, Warden King, Ltd., Montreal, introduced Col. C. L. Mackay, Bruce Stewart Foundry, Ltd., Charlottetown, who extended the official welcome to the assembled delegates.

Following the opening address, Harold J. Roast, Canadian Bronze Co., Montreal, opened the program with the first technical paper. Mr. Roast, an Honorary Life Member and former National Director of A.F.A., spoke on "Brass and Bronze Foundry Practice." Discussion leaders were C. J. Converse, Crane, Ltd., Montreal, and Chapter Vice-Chairman A. E. Cartwright, Canadian Foundry Supplies & Equipment, Ltd., of the same city.

The technical program was resumed Friday evening after the conference dinner. E. N. Delahunt, Warden King, Ltd., and a former Chairman of Eastern Canada and Newfoundland chapter was the speaker; his subject, "Cupola Operation." Norman McPhee, Dept. of Mines and Resources, Ottawa, and George Beaton, Dominion Steel & Coal Co., Sydney, Nova Scotia, served as discussion leaders.

Concluding session of the conference was held Saturday morning. William Bradley, Dominion Engineering Works, Ltd., Lachine, Que., discussed "Gating and Heading of Castings," and I. G. Sheppard, Beach Foundry Co., Ottawa, described "Production of Cast Iron for Stove Plate."

Schedule Exposition On Materials Handling

MATERIALS HANDLING PROBLEMS, including those of the foundry industry, will be analyzed in a program of prepared papers and panel discussions during the first national Materials Handling Exposition, at the Public Auditorium, Cleveland, January 14-17.

All phases of materials handling will be considered, and all types of equipment will be on display, including hoists, cranes, derricks, conveyors, hand and power trucks, skids and pallets, tractors and trailers. An interesting feature of the meeting will be a Materials Handling Rodeo on January 15.

Each type of equipment will be demonstrated under conditions simulating actual warehouse operation. The event will be conducted by the American Warehousemen's Association, which holds its 56th annual national convention in Cleveland, January 15-17, with headquarters at the Hotel Statler.

During the Rodeo, Col. A. B. Drake, Drake, Stevenson, Sheahan, Barclay, Inc., New York, who will be in charge, will discuss the equipment in operation, presenting details regarding specific applications, price, etc. Time records will be made available to those in attendance.

Patternmaking Program Committee Announced

PROGRAM AND PAPERS COMMITTEE for the A.F.A. Patternmaking Division will be under the chairmanship of Division Vice-Chairman A. F. Pfeiffer, Allis-Chalmers Mfg. Co., Milwaukee, with H. K. Swanson, Swanson Pattern & Model Works, East Chicago, Ind., as Vice-Chairman. Other members of the committee are:

J. W. Costello, American Hoist & Derrick Co., St. Paul, Minn.; F. H. Goodwin, Goodwin-Bradley Pattern, Providence, R. I.; G. A. Pealer, Elmira Foundry Co., Inc., Elmira, N. Y.; E. W. Pierie, Motor Pattern Co., Cleveland; H. E. Lees, Whitin Machine Works, Whitinsville, Mass.; Martin Rintz, Continental Foundry & Machine Co., East Chicago, Ind.; W. G. Schuller, Caterpillar Tractor Co., Peoria, Ill., and A. H. Stenzel, Stenzel Pattern Works, Houston.

Ontario and Quebec delegates, gathered at Montreal Central Station prior to leaving for the Maritime Regional Conference at Charlottetown, Prince Edward Island, September 27-28.

COLLEGE GRADUATES IN THE CASTINGS INDUSTRY

ALL FOUNDRY DEPARTMENTS NEED ENGINEERING COLLEGE GRADUATES

Max Kuniansky

MAX KUNIANSKY, National Vice-President, is vice-president and general manager of the Lynchburg Foundry Co., of Lynchburg, Va. He is a graduate of the Georgia School of Technology, Atlanta, Ga. Mr. Kuniansky has been associated with the Aetna Explosive Co. (now Hercules Powder Co.), National Malleable & Steel Castings Co., and American Cast Iron Pipe Co. Mr. Kuniansky relates, in his article which appears below, that colleges perform a valuable service by providing men suitable for many positions in the castings industry.

Foundry technology has developed to such an extent that almost every phase of foundry operation is in need of college trained men. Technical advances and process improvements in the castings industry have been outstanding in the last three decades. As a result, the need of the foundry industry for graduate engineers and graduate metallurgists is greater today than at any other time.

The metallurgical engineer and the chemical engineer are well established in the industry, although more foundries could make use of these types of men. Increasing mechanization of the industry is creating a demand for the talents of more mechanical and electrical engineering graduates. The industrial engineer is finding his way into a foundry organization through the methods engineering or the standards department. The current manpower problem offers a challenge to college men able to handle training, personnel and public relations problems.

Foundries, large and small, can and should make greater use of college graduates. Management, particularly in smaller plants, often feels that a college graduate is not practical, wants too much money and will need an expensive laboratory in order to carry on his work. Naturally, it is impossible to hire a recent graduate with 20 years experience and the answer to every foundry problem; it is also difficult to find an experienced man with the mental tools to solve rapidly, efficiently and correctly many of the new technical problems confronting foundrymen today. These tools, sharpened by intensive training in an accredited engineering college, can be put to many uses by foundrymen.

Foundry owners and managers are discovering that a properly trained metallurgist, chemist or engineer not only does well the particular work for which he is hired, but, also, is able to do good work in fields often considered non-technical. Thus, an increasing number of customers find they are being sold castings by engineers who know the details of casting design and production in addition to costs and delivery rates. In addition, the engineer-salesman usually can tell the customer exactly why castings of certain types should be used for specific applications. Purchasing agents with technical training are better able to judge materials and supplies on their merits, and make fewer decisions based on price as the major factor.

Engineers, turned cost accountants, insist that the best cost accountants for a metallurgical industry, such as the foundry, are those who were trained first as engineers. Melters in increasing numbers are being selected from the ranks of metallurgists and chemical engineers who have started in the foundry as apprentices and worked their way up.

Smaller foundries may not require the services of a full time engineer. Nevertheless, an engineer is still a good investment because he can devote part of his time to technical problems and part to sales, purchasing, or other so-called non-technical jobs. An engineer in a small foundry has a definite advertising value too. Engineers are still rare enough among smaller shops so that occasional mention of the fact by foundries employing them is impressive to customers.

Colleges perform a valuable service by providing men potentially suitable for many positions in the castings industry. Technical schooling, plus a plant training course such as the one recommended by the A.F.A. Subcommittee on Engineering Apprentice Training, enables these young men to develop rapidly and to become valuable foundry employees.

Foundries must enter the competition for college men, recruiting them and bidding for them in the same way that other industries do. The growth of the industry will con-

tinue to be comparable to that of other industries only if we make use of the men who have the vision and training to exploit all the possibilities the foundry industry presents.

COLLEGE GRADUATES IMPORTANT IN PRODUCTION AND RESEARCH


G. K. Dreher

G. K. DREHER, National Director, is vice-president and general manager of Rogers Pattern & Foundry Co., Los Angeles. He is a graduate of Lawrence College, Appleton, Wis. Mr. Dreher was formerly connected with Ampco Metal, Inc., Milwaukee, for 16 years. Has served as a past secretary, vice-chairman and chairman of the A.F.A. Wisconsin chapter. In the article which appears below, Mr. Dreher comments upon the significant cooperation which prevails between the practical self-trained men of the industry and college trained engineers in producing quantities of wartime and peacetime material.

The contributions which college trained mechanical and metallurgical engineers have made to the foundry industry are especially apparent when the wartime achievements of these men are surveyed.

Most significant is the cooperation which prevailed between the practical, self-trained men of the industry and these engineers. Their combined efforts helped produce in great quantities the basic structural items for wartime machines and weapons. This cooperation is continuing through the reconversion period when technical ingenuity, planning and cost consciousness are helping to solve the problem of labor shortages and to adapt untrained men to the needs of the foundry.

For confirmation, it is only necessary to consider the accomplishments resulting from the cooperation of practical foundry managers and technically trained college men in producing foundry products for the aircraft engines which helped establish America's supremacy during the war. No better example of the combination of foundry art and foundry technology can be found in our whole wartime experience.

College graduates will continue to be important to research as well as production. Curtailed by the war, foundry research is being revived in foundries everywhere. Educational institutions, whose research programs generally are of the pure science type, are broadening their activities now that graduate students are increasing in number. In selecting research projects, they are aided by an A.F.A. committee which suggests and outlines research projects for engineering schools. Commercial research laboratories are turning from war production problems to those of a more fundamental nature. As a result, castings of the future will be even more improved in quality and in serviceability.

CAREER AND ADVANCEMENT OFFERED ENGINEERING COLLEGE GRADUATES


Hyman Bornstein

HYMAN BORNSTEIN, past National President, is director of the testing and research laboratories, Deere & Co., Moline, Ill. Graduated from Armour Institute of Technology, Chicago, with a degree in chemical engineering and later received an LL.B degree from John Marshall Law School, Chicago. Has been affiliated with the Union Pacific Railroad, Swift & Co., chemist for the city of Chicago and served as a Captain, Ordnance Department, World War I. Mr. Bornstein, whose article appears below, points out that the foundry industry offers engineering school graduates much opportunity, interesting work, and good compensation.

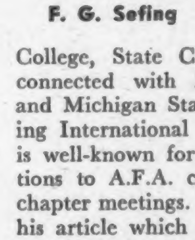
The foundry industry offers graduates of engineering schools excellent opportunities for, interesting work, good compensation and advancement. Probably no other industry presents so many perplexing problems in high temperature chemistry and physics, or offers a greater challenge to the engineer interested in work routing and materials handling. Chances for rapid advancement far outweigh any consideration of starting salaries, which in a few industries may be higher than in some parts of the industry.

The management of plants producing quality castings needs more men with a background of formal education and practical foundry experience. This demand has been brought about by increased mechanization of foundries and more rigid requirements on dimensional tolerances, chemical analyses and mechanical properties.

More and more, management is selecting properly qualified engineering school graduates and providing them with opportunities for training and advancement. These young men are selected on the basis of their scholarship, their willingness to learn, their desire to advance through their work, and their interest in the foundry industry. Ability to get along well with fellow workers, and to lead as well as follow, are of prime importance and are sought in young college graduates.

Too often, technically trained men have been lost to the foundry industry because management has failed to take full advantage of the talent available. Recognizing its obligation, management is providing for the training and advancement of college men after they have been brought into a plant. Management and the engineering apprentice supervisor observe the men during training, advise them on their work and consult with them on personal problems.

COMPETITION FOR ENGINEERING COLLEGE GRADUATES KEEN


F. G. Sefing

F. G. SEFING, Chairman, A.F.A. Educational Division, is metallurgist of International Nickel Co., New York. Obtained his degree from Lehigh University, Bethlehem, Pa., and later received his Master's degree from Pennsylvania State College, State College, Pa. Had been connected with Rockford Drop Forge and Michigan State College before joining International Nickel Co. Mr. Sefing is well-known for his frequent contributions to A.F.A. conventions and A.F.A. chapter meetings. Mr. Sefing discusses, in his article which appears below, the recruiting job which the casting industry must carry out in order to obtain the cream of the crop of engineers which graduate from the campuses of American colleges.

In recruiting engineering college graduates for work in the castings industry, foundries are in competition with other great industries, most of which have long been advertised in the colleges by various methods and, accordingly, are much better known to the students. The power, automotive, steel, chemical and other industries, have a competitive advantage primarily because of longer experience in the field of soliciting prospective employees. The castings industry must meet the competition by offering every inducement possible. These include bringing out the opportunities for rapid advancement, a review of some of the interesting engineering problems faced by foundries, and, where necessary, making competitive salary offers.

From January to May, each year, other industries send personnel men all over the country to pick the cream of the crop of engineers directly from college campuses. Foundries, too, must make their selection early, or else the most ambitious and progressive students will have been chosen, leaving the less desirable men to the castings industry. Foundries unable to make an extensive search for engineering graduates can confine their efforts to engineering schools in their area. In several A.F.A. chapter areas, recruiting of college students is carried on as a chapter function. This is done by the Twin City chapter which offers prizes to University of Minnesota students for papers related to the castings industry. The three prize winners present their papers at a chapter meeting, and frequently all are hired before they leave the meeting place.

Foundries can sell the castings industry to students with little effort, by describing and illustrating the fascinating business of making castings. Too often, the idea of the industry given to a student by a college foundry course is wholly inadequate, usually not representative and often misleading. In addition to the fascination of correlating a wide variety of engineering and metallurgical activities, the employer can point out the need for control of materials and equipment, and, finally, the conversion of a ladle of molten metal to an intricate casting for use by another industry.

The desire on the part of a student to become a foundry engineer, developed through his foundry instructor and through castings industry educational activities, will be lost if foundries do not demonstrate sufficient interest by seeking the young man's services. The employer must also assist the graduate in the transition from academic thinking to industrial thinking by putting him through some sort of an engineering apprentice course.

In seeking the services of engineering graduates and developing them into foundry engineers, foundrymen may look for assistance to the A.F.A. Educational Division and to the A.F.A. chapter educational committees. Schools are training students in the fundamentals of engineering, thus fitting them for every type of foundry work. Graduates are available, even though there is considerable competition for them from other industries.

ENGINEERING COLLEGES RESPONSIBLE FOR EDUCATING FOUNDRYMEN

A. C. Denison

A. C. DENISON is president of the Fulton Foundry & Machine Co., Inc., Cleveland. He is a graduate of Case School of Applied Science, Cleveland. Mr. Denison had been affiliated with the National Carbon Co., and the Ferro Foundry & Machine Co., prior to his joining the Fulton foundry. A past chairman of the A.F.A. Northeastern Ohio chapter, he has been a member of the Association since 1927. Mr. Denison is active in the Meehanite Research Institute and has served a two-year period as president of the Gray Iron Founders' Society. In his article, which appears below, Mr. Denison points out that the need for better trained men in the foundry industry is quite evident but is not yet fully recognized by many educational leaders.

Opportunities for college men in foundries are not entirely clear to some college executives, probably because they are not well acquainted with the castings industry. The need for better trained men in the industry is becoming more evident, but is not yet fully recognized by many educational leaders.

The fact is that the foundry industry has advanced to such an exact engineering basis that only well educated men can supply proper leadership. Such men must get their knowledge through regular college training or through extra study as special adult students.

In general, castings are made to definite requirements and ranges of specifications today. To achieve this, foundries must have men who understand the theories and practice of engineering. Experience alone is not sufficient; there are too many factors to be appraised. Reasoning based on broad understanding is required for high production of castings with guaranteed quality.

The need for better trained men does not come from the refinements and greater skill needed in manufacture alone. Better trained men with broader outlook are required for methods supervisors, who must understand modern equipment, job evaluation and use of synthetic rates; superintendents, who must handle men well and maintain their respect; salesmen, who must sell and service on a technical and engineering basis, and executives, who must be able to balance all the complicated factors that influence modern business. Current demands for better products at lower costs make better training for all these types of men essential.

In performing their function of providing basic engineering training, colleges must see that the instruction offered in foundry practice is on an engineering, rather than a manual training level. In addition, advanced courses for the benefit of engineering and metallurgical students particularly interested in the castings industry should be offered. Recommendations for such courses have been prepared by an A.F.A. committee made up of some of the foremost college foundry instructors in the country.

A second function of engineering colleges is to educate men already working in the castings industry. Some colleges offer special courses to adult students not interested in a degree in engineering. Others hold technical short courses and, in some cases, send instructors into the plant where a single foundry can organize a group large enough for a class. These special classes permit able, experienced foundrymen to learn the fundamentals of chemistry, physics,

metallurgy, personnel relations, principles of management, etc. These courses, coupled with practical experience, provide foundrymen with a sounder basis for making decisions and for organizing work.

Some A.F.A. chapters have taken over the second function of colleges, and are offering an integrated series of lectures on a single phase of foundry practice. In such cases, lectures are given by experienced foundrymen and college instructors who are A.F.A. members.

COLLEGES RECOGNIZE AND FULFILL CASTINGS INDUSTRY NEEDS

Dr. H. T. Heald

DR. H. T. HEALD is president of the Illinois Institute of Technology, Chicago. Dr. Heald is the holder of two honorary degrees; namely, Doctor of Engineering, Rose Polytechnical Institute, Terre Haute, Ind., and Doctor of Law, Northwestern University, Evanston, Ill. He has served as a past president of the Western Society of Engineers and also the Society for the Promotion of Engineering Education. In 1940 was named by the National Junior Chamber of Commerce as one of America's ten outstanding young men of the year. Dr. Heald informs the country's foundrymen, in this discussion, which is taken from his talk presented at the Chapter Chairman Conference held in Chicago during July, that securing college graduates may be difficult because the war caused a deficit of more than 50,000 graduate engineers.

Foundrymen, as representatives of an industry which depends upon technological processes to a very large extent, have reason to be concerned about the quality and quantity of the men who will be trained to take their places, some day, in foundry operation and management. Certainly the future productive capacity of the castings industry and its ability to meet competition and keep abreast of the rapid changes continually taking place in technological processes, depend, to a large degree, upon the intelligence, character and skill of the engineers, scientists and technicians called upon to build and operate the foundries, and to develop new products and materials and distribute them to the consumer.

Securing college graduates may be difficult for some time, because the war has caused a deficit of more than 50,000 graduate engineers. According to a committee which studied the matter for the American Society for Engineering Education, it will be 1950 or later before the supply and demand for engineering graduates are again in reasonable balance. In the meantime, foundrymen expecting to hire college graduates must face the competition of all other industries which are interested in these men and which seem to have had considerably more experience in recruiting college men.

Colleges providing engineering education have a responsibility to the public, a responsibility to industry and a responsibility to the profession of engineering itself. They have, also, a very definite responsibility to the students, and this responsibility, for the most part, determines the methods which are followed in engineering education. First of all, engineering colleges try to provide some training in the sciences which are basic to engineering. In addition, there is some work in the development of elementary technical skills, and an introduction, at least, to what is called the engineering method. If he has not learned it before, the engineering student must learn to read, write and speak effectively.

To achieve these aims, there is a trend in engineering colleges toward a better fundamental education, and toward more emphasis on the fundamental sciences. The result is perhaps a minimization of specialized technological matter in the later college years. This does not mean, necessarily, that those things are not taught; but it does frequently mean they do not appear in the four-year undergraduate curriculum. The expansion of knowledge in all fields of engineering has been very great in the past twenty years, and there is more and more material which might be included in college courses. But it cannot be done effectively in a limited amount of time, although many schools offer options in specialized fields which permit the student some latitude in his education.

Foundrymen and the American Foundrymen's Association have every right to be interested in the problem of engineering education. Any interest displayed in educational institutions will be appreciated by the faculty, and it is certain that the interest shown and the work done on problems of engineering education will be of real benefit to the castings industry.

Champions of the Olympic Industrial League, Worcester, Mass.—these foundrymen of the softball team from Standard Foundry Co., of that city: Company officers and team members, left to right: standing, A.F.A. National Director H. H. Judson, foundry superintendent; G. F. Hutchins II, treasurer; C. F. Hutchins, president; C. W. Hutchins, general manager, and P. K. Baker, office manager. Center, James Barbato, coremaker; Edward Kubicky, floor molder; Victor Chad, sidefloor molder; Clarence Smith, core paster, and Robert Kennedy, coreroom foreman. Forefront, Coli DiPilato, bench molder; John Urbec, squeezer molder; Charles Perks, pattern boy; Richard Pichette, maintenance man; William McKenzie, coremaker, and Gordon Place, bench molder.

CHAPTER OFFICERS

D. C. Zuege
Sivyer Steel Casting Co.
Milwaukee
President
Wisconsin Chapter

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The Pitcairn Co.
Barberton, Ohio
Vice-Chairman
Canton District Chapter

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Canadian Foundry Supply & Equip. Co., Ltd., Montreal, Que.
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Bunting Brass & Bronze Co.
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Director
Toledo Chapter

C. E. Silver
Michigan Steel Casting Co.
Detroit
Vice-Chairman
Detroit Chapter

★ CHAPTER ACTIVITIES ★

news

No. Illinois—So. Wisconsin

H. J. Bauman
Ebaloy, Inc.
Chapter Secretary

SAND PROBLEMS were the concern of members and guests at the season's initial meeting for Northern Illinois and Southern Wisconsin A.F.A. chapter, September 10 at the Hotel Faust, Rockford, Ill. Speaker of the evening was F. L. Overstreet, Illinois Clay Products Co., Chicago, who analyzed the relation of sand properties to casting defects.

The speaker, a member of the Analysis of Casting Defects Committee, A.F.A. Gray Iron Division, presented slides illustrating casting defects and their causes. He pointed out that sand properties are a big factor in foundry scrap, and cited figures on ferrous production in this country for 1944, giving a total loss due to scrap of 87 billion dollars.

Mr. Overstreet emphasized the importance of laboratory control in the foundry, as well as the necessity of keeping foremen informed on all phases of operations related to their individual responsibilities.

Ontario

G. L. White
Westman Publications, Ltd.
Chapter Secretary

NO SIMPLE RECIPE will meet the diverse sand requirements of all types of foundries, C. A. Sanders, American Colloid Co., Chicago, pointed out to the 135 members and guests present at the meeting of Ontario A.F.A. chapter, September 20, in Hamilton, Ont. Mr. Sanders was technical speaker of the evening on the subject of "Foundry Sand Practice."

Chapter Chairman J. A. Wotherspoon, Imperial Iron Corp., Ltd., St. Catherines, Ont., presided, and Chapter Director R. A. Woods, George F. Pettinos (Canada), Ltd., Hamilton, introduced the speaker.

Mr. Sanders presented a comparison of the properties of synthetic and natural sands, citing advantages and disadvantages for each. Certain basic properties, he stated, are of the greatest importance in deter-

Chapter Chairman-Elect Henri Louette (fourth from left, front row), Warden King, Ltd., Montreal, presents an A.F.A. medal to his predecessor, G. E. Tait, Dominion Engineering Works, Ltd., Lachine, Que., at the Annual Meeting of Eastern Canada and Newfoundland A.F.A. chapter, May 1, in the Mount Royal Hotel, Montreal. Also shown are: back row, chapter Directors, Del Allard, Arts and Crafts School, Provincial Government; D. H. Newman, Chamberlain Engineering (Canada), Ltd.; W. J. Brown, Robert W. Bartram, Ltd., all of Montreal; C. C. Brisbois, Sorel Industries, Ltd., Sorel, Que., and E. Laurendeau, Canadian Pattern & Woodworking Co., Montreal. Front, Chapter Secretary R. E. Cameron, Webster & Sons, Ltd., and Chapter Vice-Chairman A. E. Cartwright, Canadian Foundry Supplies & Equipment, Ltd., both of Montreal; G. E. Tait; Henri Louette; Chapter Director H. E. Francis, Jenkins Bros., Ltd., Montreal, and Chapter Treasurer L. G. Guilmette, Canadian Foundry Supplies & Equipment, Ltd.

C. A. Sanders, American Colloid Co., Chicago, discussing "Foundry Sand Practice" at the September 20 meeting of Ontario A.F.A. chapter, in Hamilton.

mining success or failure of either synthetic or natural sand; and he listed among such properties, grain distribution, density and moisture content.

Up-to-date methods of sand control, the speaker stressed, are becoming more important, and such control should be in the hands of a competent sand man. The latter, Mr. Sanders advised, should be given sufficient authority to enable him to trace the cause of all failures, so that failures from other factors are not attributed to sand.

During the business session, R. T. Robertson, International Harvester Co. of Canada, Hamilton, announced the foundry course at the local F. R. Close Technical Institute, which course is being sponsored by Hamilton foundries in cooperation with the Ontario A.F.A. chapter. It is specifically designed for education and advancement of young foundrymen.

Cincinnati District

E. F. Kindinger
Williams & Co.
Chapter Secretary

QUESTIONS AND ANSWERS on sand held the attention and drew out the observations of approximately 110 foundrymen present at Engineering Society Headquarters, Cincinnati, on September 9, the first meeting of the season for Cincinnati District A.F.A. chapter.

Chapter Chairman J. F. Schumacher, Hill & Griffith Co., Cincinnati, presided, and a 'board of experts' answered questions from the members and guests and directed questions at fellow board members. The active discussion pertained to iron, non-ferrous and steel sand conditions and brought out information of interest to everyone present.

Members of the forum panel were: Edward King, Hill & Griffith Co.; William Ball, Magnus Brass Div., National Lead Co.; J. B. Caine, Sawbrook Steel Castings Co., and Walter Klayer, Aluminum Industries, Inc., all of Cincinnati, and J. D. Judge, Hamilton Foundry & Machine Co., Hamilton, Ohio. Attendance for the meeting drew foundrymen from Dayton, Hamilton, Lawrenceburg and Cincinnati.

Northern California

C. R. Marshall
Chamberlain Co.
Chapter Co-Secretary

GET ACQUAINTED–GET TOGETHER Night launched the season for Northern California A.F.A. chapter, September 13 at the Engineer's Club, San Francisco. New program chairman George McDonald, H. C. Macaulay Foundry Co., Berkeley, presented a line-up featuring a travel talk by a chapter member, J. L. Francis, Vulcan Foundry Co., Oakland, who recently returned from a trip to Mexico and South America.

Mr. Francis reported on conditions and practices in the many foundries in which he worked during his trip, and in addition, described the beauties and customs of the countries, exhibiting a number of fine pictures which served as an outline for his remarks.

Chapter President Richard Vosbrink, Berkeley Pattern Works, Berkeley, presiding, presented the new membership chairman, H. M. Donaldson, Brumley-Donaldson Co., San Francisco. Mr. Donaldson introduced these new members:

A. B. Morse, C. E. Beckett, R. F. Wilmer and A. E. Weidenbacker, all of Gladding McBean & Co., Los Angeles; L. L. Little, H. C. Little Burner Co., San Raphael, Calif.; Robert Grover, Palmquist Brass, Bronze & Aluminum Foundry, Oakland; Davis Taylor, American Foundry Equipment Co., San Francisco, and Walter Berkley, Westinghouse Electric Corp., of the same city.

President Vosbrink reported on the Chapter Chairman Conference, held in Chicago, July 24-25, and explained the many new and valuable suggestions for increasing the value of the chapter to its members and the local foundry industry, which were given those in attendance at the conference. Of particular importance, Mr. Vosbrink said, was the opportunity to meet the chairmen of other chapters and exchange ideas and experiences.

A report on the Annual Meeting of the A.F.A. Board of Directors was given the chapter members by National Director S. D. Russell, Phoenix Iron Works, Oakland.

Announcement was made that the regional foundry conference planned for spring of the coming year will be arranged as a section of the Western Metals Congress, sponsored by the American Society for Metals. Charles J. P. Hoehn, Enterprise Engine & Foundry Co., San Francisco, has been named chairman, committee on arrangements for participation, and E. M. Nystrom, Vulcan Foundry Co., is chairman, committee on A.F.A. program.

Among those present for this first meeting of the season were five former Chapter Presidents: Charles J. P. Hoehn; H. A. Bossi, H. C. Macaulay Foundry Co.; R. C. Noah, San Francisco Iron Foundry, of that city; I. L. Johnson, Pacific Steel Casting Co., Berkeley, and A.F.A. National Director S. D. Russell.

Guests of the evening included:

J. L. Hall, American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.; Victor Hoaster, Clarkson Co., Belmont, Calif.; R. L. Mostus, Minnesota Mining & Mfg. Co.; Victor Marino, San Francisco Iron Foundry Co.; Jack Brock, Chamberlain Co., San Francisco; James Rimmer, Columbia Steel Co., of the same city; Morris Furtado, Vulcan Foundry Co.; R. E. Peter, Electro Metallurgical Co., San Francisco, and George Rezenido, H. C. Macaulay Foundry Co.

Oregon

F. A. Stephenson
Dependable Pattern Works
Chapter Secretary-Treasurer

TOP FOUNDRY MANAGEMENT of the Portland, Wash., area met with A.F.A. National President S. V. Wood, Minneapolis Electric Steel Castings Co., Minneapolis, and A.F.A. Secretary-Treasurer W. W. Maloney, October 7, in the Castillian Room, Heathman Hotel, Portland.

Mr. Wood spoke briefly on the history of the foundry, and pointed out that foundrymen must show the public and students, through education, that the foundry industry offers unlimited opportunities and possibilities.

Mr. Maloney described the role of A.F.A. in the foundry industry, emphasizing the assistance available to foundrymen through the technical committees, publications and facilities of the Association.

Present at the special meeting were Chapter President W. R. Pindell, Northwest Stove & Furnace Works, Inc.; Chapter Secretary-Treasurer F. A. Stephenson, Dependable Pattern Works; and Chapter Directors A. R. Prier, Oregon Brass Works, and L. E. Bufton, Silica Products Oregon, Ltd.

Also on hand, and bringing representation of foundry business in the area to 75 per cent of total tonnage, were: Harry Baldwin, Quality Brass & Aluminum Foundry; Edward Cardinal, Vancouver Iron & Steel Foundry; Edward Huffschmidt, Industrial Iron Works; Albert Maede and Kenneth Manchester, Oregon Steel Foundry; Walter Nourse, Western Steel Casting Co.; Jack Nunn, Pacific Steel Foundry; Walter Smith, Interstate Brass Foundry; Harry Spieth, Shofner Iron & Steel Foundry; Newman Ward, Electric Steel Foundry Co., and Robert Weaver, Magnus Metal Div., National Lead Co.

Western Michigan

K. C. McCready
Muskegon Piston Ring Co.
Chapter Reporter

MORE THAN 700 members and guests of Western Michigan A.F.A. chapter attended the annual chapter outing at Spring Lake Country Club, on August 24. Clear skies and warm weather encouraged the many foundrymen to take full advantage of outdoor activities.

Golf was an all-day event and softball and horseshoe pitching were the main sports contests for the afternoon. More popular than ever this year were the cruises and speed boat rides on Spring Lake.

Following a full day of sports, a smorgasboard dinner was enjoyed at the club house, after which prizes were awarded. Climax of the day's entertainment was a floor show, which was enthusiastically received.

Chapter Chairman Rudolph Flora, Clover Foundry Co., Muskegon, Mich., was in charge of arrangements, with Chapter Secretary V. A. Pyle, Pyle Pattern & Mfg. Co., Muskegon, assisting. C. J. Lonnee, Clover Foundry Co., was master of ceremonies.

Chapter Secretary V. A. Pyle (left), Pyle Pattern & Mfg. Co., Muskegon, Mich., and Chapter Chairman Rudolph Flora, Clover Foundry Co., Muskegon, look on momentarily during a busy day at Western Michigan A.F.A. chapter's annual outing of August 24. Scene was the Spring Lake Country Club.

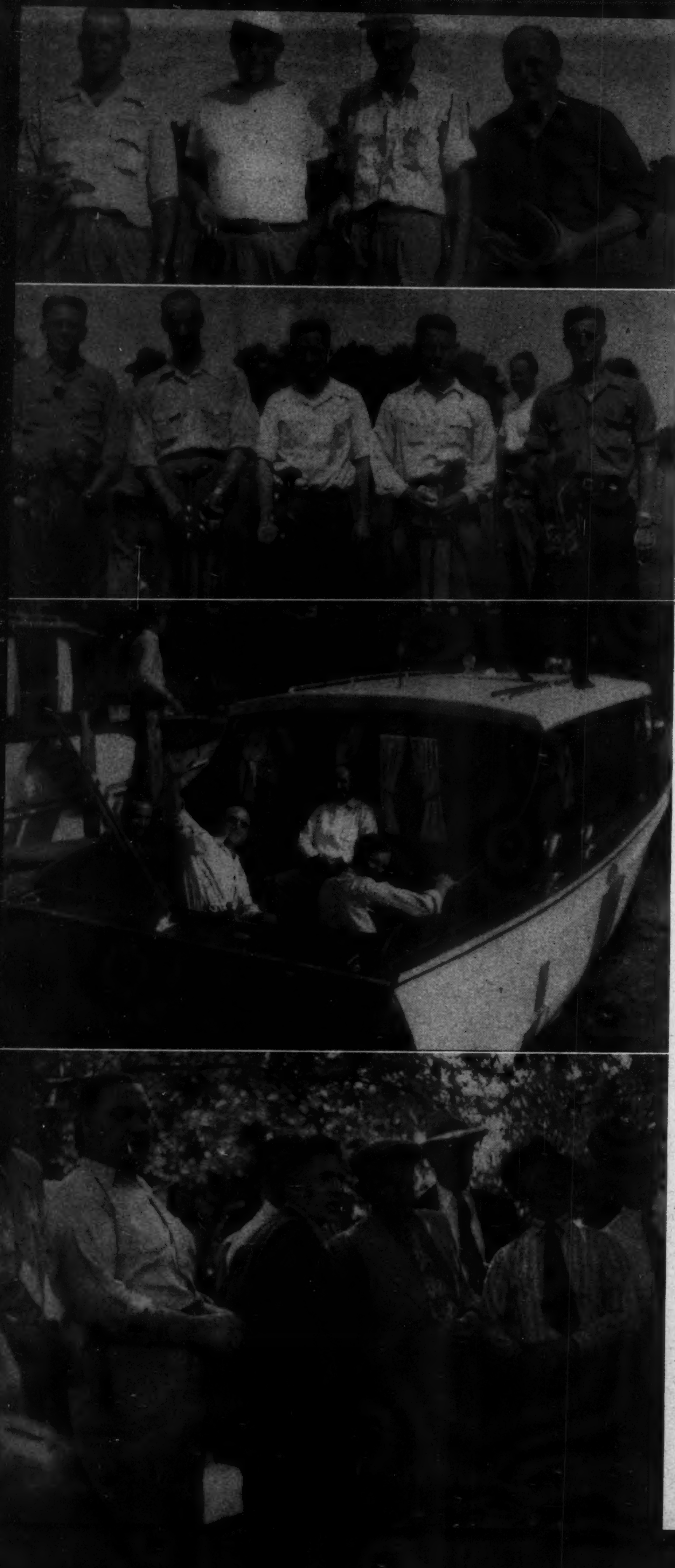
The champions—Winning team in Southern California A.F.A. chapter's "Summer Bowling Classic," this group took an early lead and was never headed. Left to right: standing, Oliver White, team captain Frank Pellegrino, Pete Pellegrino and Frank Boggs; front, Frank Felix and Pat Pellegrino, all of Monarch Aluminum Casting Co.

Southern California

G. J. Nass
Brumley-Donaldson Co.
Chapter Reporter

APPLICATIONS OF GRAPHITE in the foundry industry, as described by H. M. Rutledge, National Carbon Co., Los Angeles, proved an interesting subject for the technical session of Southern California A.F.A. chapter's September 13 meeting in Roger Young Auditorium, Los Angeles.

The speaker stressed the fact that



two different products, graphite and carbon, are supplied; and he described processing of raw materials into the finished products over a 16-week period.

Major foundry applications of carbon, as listed by Mr. Rutledge, are: electrodes, blast furnace linings, aluminum reduction, mold plugs, riser rods, centrifugal casting molds, cores, skimmer floats in non-ferrous casting, and fluxing tubes. Showing of the film, "Carbon-Black Treasure," dealing with the history and manufacture of carbon products, closed the presentation.

A short question and answer period followed, under direction of Chapter President W. D. Emmett, Los Angeles Steel Castings Co., Los Angeles.

Central New York

J. A. Foola
Crouse-Hinds Co.
Chairman, Publicity Committee

INTEREST of foundrymen throughout the Central New York A.F.A. chapter area in the activities of that group has been strikingly demonstrated in a 'mileage-travelled' study by Chapter Secretary C. M. Fletcher, The Fairbanks Co., Binghamton, N. Y., who tabulated the mileage of those travelling to the September and October meetings. The former was held on the 13th at the Hotel Langwell, Elmira; and the latter on the 11th at Onondaga Hotel, Syracuse.

For the 115 present at Elmira in September, the total one-way-mileage was approximately 5,500 miles; while the 120 people who attended the October meeting in Syracuse travelled 5,200 miles one way! The nearly 22,000 miles covered by foundrymen in attending two chapter meetings is evidence of the value of the technical sessions and other phases of chapter activities.

For both occasions, the speaker of the evening was Professor J. O. Jeffrey, Cornell University, Ithaca, N. Y.; the subject, "Metallurgy." The speaker launched his series of

These shots depict a few of the manifold activities enjoyed by the more than 700 foundrymen and guests at the Western Michigan A.F.A. chapter outing of August 24 at the Spring Lake Country Club.

talks with a discussion of metallurgical terms the first evening, explaining the following in language readily understandable to the average foundryman: composition of an alloy; constitution of an alloy; space lattices; dendrites; solid solution; chemical compound, and equilibrium diagram.

At the following session, Professor Jeffrey chose the equilibrium diagram as his topic, illustrating its use in the regard to gray iron, malleable and various non-ferrous alloys. He used motion pictures to accompany his remarks and explanations on both evenings; the two films at the second session showed the action of molten iron entering and filling the mold, and the filling of the mold cavity under different gating and risering conditions.

Section Meetings

The meetings divided into gray iron, malleable and non-ferrous sections for round table discussions following Professor Jeffrey's talks. Discussion leaders at Elmira were: gray iron, W. G. Parker, Elmira Foundry Co., of that city; malleable, D. J. Merwin, Oriskany Malleable Iron Co., Utica, N. Y., and non-ferrous, William Maeder, Oberdorfer Foundries, Syracuse.

For the October meeting, leaders were: gray iron, L. D. Wright, U. S. Radiator Corp., Geneva, N. Y.; malleable, Louis Iadarola, Malleable Founders Society, Cleveland, and, non-ferrous, C. M. Fletcher, The Fairbanks Co.

This type of meeting proved extremely popular with foundrymen who took part, and round table gatherings were scenes of animated exchange of views and experiences. Questions raised in the groups were taken up by the speaker at the following meeting.

Central Ohio

D. E. Krause
Battelle Memorial Institute
Chapter Reporter

THE SECOND ANNUAL OUTING of Central Ohio A.F.A. chapter, held at the Brookside Country Club, Columbus, Ohio, on September 13, turned out to be a repeat of last year's success. In spite of threatening weather, 200 serious-minded foundrymen turned out for the event.

Their seriousness, of course, was directed to things other than foundry problems: baseball, golf, darts and horseshoes—among other attractions on a full program. Arduous efforts were rewarded with prizes, and an excellent dinner, followed by a floor show, wound up the affair.

Quad City

ROUND TABLE DISCUSSIONS on cupola, sand and non-ferrous practices, occupied more than 100 members and guests of Quad City A.F.A. chapter, meeting September 16 at Fort Armstrong Hotel, Rock Island, Ill.

Discussion leaders for the sessions were: E. P. Closen, Deere & Co., Moline, Ill.; Chapter Director W. E. Jones, American Steel Foundries, Bettendorf, Iowa, and Chapter Chairman C. S. Humphrey, C. S. Humphrey Co., Moline.

Prior to the technical portion of the meeting, Dr. H. C. McKowan, Galesburg, Ill., delivered the coffee

It might be a board of strategy meeting (upper right) that Chapter Chairman N. J. Dunbeck (center, hands in pockets), Eastern Clay Products, Inc., Eifort, Ohio, is holding; but it is more likely just a pause in the general enjoyment seen in the other three scenes from the second annual outing of Central Ohio A.F.A. chapter, September 13 at the Brookside Country Club, near Columbus, Ohio.

talk. He told the foundrymen that progress has always been made only against the objections of those accustomed to established traditions.

Birmingham District

J. P. McClendon
Stockham Pipe Fittings Co.
Chairman, Publicity Committee

FOUNDRYMEN of the Birmingham District A.F.A. chapter put over one of the biggest events of the year September 14, when they staged their 13th annual outing and barbecue at the Roebuck Country Club.

More than 700 tickets for the event went out to foundrymen and their friends, the distribution being handled by J. F. Curry, Alabama By-Products Co., Birmingham. C. B. Saunders, Woodward Iron Co., served as sergeant at arms.

Good Job

General chairman of the outing, and accorded the hearty appreciation of the chapter for a job well done, was J. M. Bates, Moore-Handley Hardware Co., Birmingham.

An athletic program, headed up by Gene Welchel, American Cast Iron Pipe Co., Birmingham, kept the foundrymen in action from early morning until late evening. Included on the schedule were golf, swimming, horseshoe pitching and a softball game—in which the "Foundrymen Giant Killers," captained by Sam Carter, American Cast Iron Pipe Co., appropriately overcame the "Supplymen Giants," under leadership of Harry Mouat, H. G. Mouat Co., Birmingham.

Saluted as the oldest Old Timer at the outing was Michael James Hayes, who retired as superintendent, Central Foundry Co., Holt, Ala., in 1938, after a career of 55 years in the foundry industry. Born

W. Carson Adams, Birmingham District chapter director, W. Carson Adams, Birmingham, Ala.

in Morristown, Tenn., in 1867, he entered the industry in 1883 in Anniston, Ala., and was later associated with United States Cast Iron Pipe Co., Bessemer, Ala., and the Alabama Pipe Co., Anniston, before joining the Central firm in 1923. A member of A.F.A., he finds his greatest pleasure in maintaining his contacts in the foundries, and is known in the area as the "Grand Old Man of the Foundry."

Texas

R. H. Glenney
Alamo Iron Works
Chapter Director

A DINNER MEETING at the Golfcrest Country Club, Houston, September 27, inaugurated the 1946-47 season for Texas A.F.A. chapter. Chapter Chairman W. M. Ferguson, Texas Electric Steel Castings Co., Houston, presided; and 47 members and guests were on hand.

W. H. Lyons, Hughes Tool Co., Houston, presented the technical discussion of the evening, a prepared paper on "Fundamentals of Foundry Metallurgy." He supplemented his remarks with slides, and also presented an exhibit of a small steel casting with an open riser attached. The sample was cross-sectional, to demonstrate the successful use of a "break-off" riser.

Coffee talk of the evening was on "Football Prospects for the Southwest Conference," by Bruce Layer, sports writer, *The Houston Post.*

Representing new membership at the meeting were W. L. Heirman and H. T. Speer, both of Tips Engine Works, Austin, Texas, and M. J. Henley, Texas Foundry Co., Lufkin, Texas, whose membership has been transferred from the Birmingham District chapter.

(Continued on Page 84)

The "Big Outing" for Birmingham District A.F.A. chapter, September 14 at the Roebuck Country Club. Top: left, Michael James Hayes, retired foundryman and oldest Old Timer present; right, tense moment during the close horseshoe pitching competition. Below, left to right: the general committee (Chairman J. M. Bates, Moore-Handley Hardware Co., Birmingham, at right rear); the "Foundrymen Giant Killers" softball team (winners), and the "Supplymen Giants" team, which came in second.

(Photos courtesy John Graham, Stockham Pipe Fittings Co.)

CHAPTER MEETINGS

NOVEMBER-DECEMBER

November 21

Detroit

Rackham Memorial, Detroit
ROUND TABLE DISCUSSION

REGIONAL CONFERENCE

November 21-22

Chicago and Central Illinois

Continental Hotel, Chicago

November 22

Chesapeake

Engineers Club, Baltimore, Md.
D. FRANK O'CONNOR
American Saw Mill Machinery Co.
Brass

November 25

Central Ohio

Chittenden Hotel, Columbus
ROUND TABLE DISCUSSIONS
Casting Defects

November 29

Northwestern Pennsylvania

Moose Club, Erie
CLYDE A. SANDERS
American Colloid Co.
Rockets in World War II

Ontario

Royal Connaught Hotel, Hamilton
ROUND TABLE DISCUSSION

December 2

Central Illinois

Jefferson Hotel, Peoria
N. J. DUNBECK
Eastern Clay Products, Inc.
How to Select a Bond Clay

December 3

Michiana

G. R. TARGETT
Sibley Machine & Foundry Corp.
Cost and Selling Price

December 5

Chicago

Chicago Bar Association
NEW 50 YEAR MEN NIGHT
QUIZ NIGHT

Saginaw Valley

Fischer's Hotel, Frankenmuth, Mich.
ROUND TABLE DISCUSSION

December 6

Metropolitan

Essex House, Newark, N. J.
CHRISTMAS PARTY

Ontario

Prince Edward Hotel, Windsor
DR. RALPH L. LEE
General Motors Corp.
Human Relations

Texas

San Antonio
H. W. DIETERT
H. W. Dietert Company
A General Review of Sand Problems

December 12

Western New York

Hotel Touraine, Buffalo.
Job Evaluation

Northeastern Ohio

Carter Hotel, Cleveland
CHRISTMAS PARTY

Canton District

Yant's Cottage, Canton
FRED G. SEFING
International Nickel Co.
Recent Development of Sound Castings

December 13

Philadelphia

Engineers Club
J. B. CAINE
Sawbrook Steel Castings Co.
What Is Strength?

December 14

Western Michigan

Spring Lake Country Club, Grand Haven
CHRISTMAS PARTY

December 16

Central Ohio

Chittenden Hotel, Columbus
BRUCE SIMPSON
National Engineering Co.
History of Casting Industry

December 19

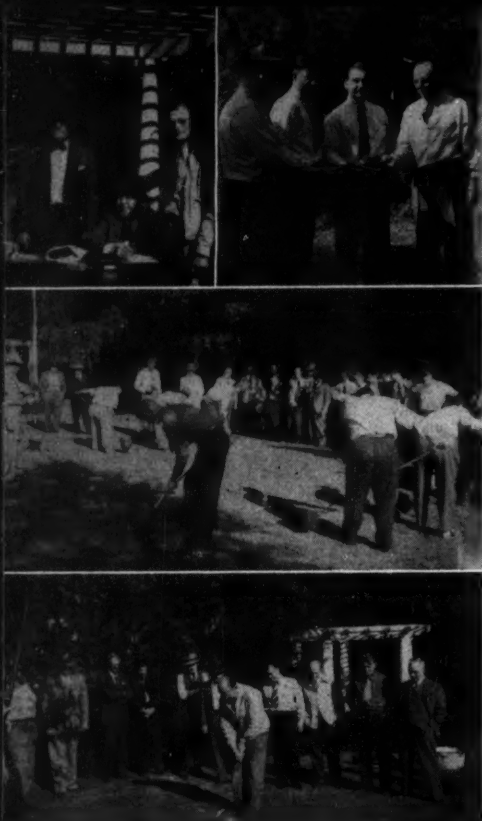
Philadelphia

Engineers Club
CHRISTMAS PARTY

December 21

Cincinnati District

Engineering Society Headquarters
Cincinnati
CHRISTMAS PARTY



Scenes from Northwestern Pennsylvania A.F.A. chapter's picnic, September 14 at Tiemann's Grove, Erie: Top, left, the reception committee grouped around William Bartals (seated), Erie Malleable Iron Co., Erie, entertainment committee chairman; right, three chapter Directors matching horseshoes with the Chapter Chairman E. M. Strick, Erie Malleable Iron Co. (at extreme right). Center, naturally at a foundrymen's picnic, hot competition in the pouring contest. Bottom, 'pouring it on' the putter.

Chapter Director DeWitt McKinley, McKinley Iron Works, Fort Worth, Texas, outlined recent efforts to obtain relief on allocation of pig iron to foundries, and Vice-Chairman L. H. August, Hughes Tool Co., announced plans for round table discussions at future meetings.

Western New York

L. A. Merryman
Tonawanda Iron Corp.
Chapter Secretary

INTEREST in sand control on the part of 75 members and guests at the October 4 meeting of Western New York A.F.A. chapter, in the Hotel Touraine, Buffalo, was demonstrated in a lively discussion period following a talk by C. A. Sanders, American Colloid Co., Chicago, on "Foundry Sand Practice." Presiding at the meeting was Chapter Chairman H. C. Winte, Worthington Pump & Machinery Corp., Buffalo.

Mr. Sanders opened his remarks with a discussion of synthetic and natural sands, comparing qualities and advantages of each; and stated that there are qualities in natural sands which have not been duplicated in the synthetic.

Emphasizing the importance of obtaining all pertinent facts in establishing the causes of casting losses, the speaker pointed out that laxity in foundry controls is often responsible. Sand is frequently blamed, he said, when the trouble may be traced to such factors as use of too many gaggers, flasks with bars too close to the casting, worn closing pins, etc.

The speaker dealt with sand density in considerable detail, remarking that there is a definite trend toward emphasizing the importance of this phase in control, in sand preparation through the use of graded sands.

Northwestern Pennsylvania

J. E. Gill
Lake Shore Pattern Works
Chapter Director

FOUNDRY ECONOMICS was the subject of the first technical session of the chapter season for Northwestern Pennsylvania A.F.A. chapter, meeting September 23 at the Moose Club, Erie, with Chapter Chairman E. M. Strick, Erie Malleable Iron Co., of that city, presiding. C. E. Westover, Westover Engineers, Milwaukee, discussed "Cost Control and Wage Incentives in the Foundry."

Among the more than 130 foundrymen present were a number of out-of-town guests, including: H. J. Trenkamp, The Ohio Foundry Co., Cleveland, President of Northeastern Ohio A.F.A. chapter; the Secretary of that chapter, G. J. Nock, The Nock Fire Brick Co., Cleveland; Harry Reitinger, Emerson Engineers, New York, a past Chairman of Philadelphia A.F.A. chapter; and T. E. Eagan, Cooper-Bessemer Corp., Grove City, Pa., Chairman, A.F.A. Gray Iron Division.

In presenting a constructive talk on controlling labor and miscellaneous costs, Mr. Westover suggested three basic requirements: a good organization—clear division of responsibility; a careful analysis of work requirements in various jobs throughout the plant, and translation of the results of such analysis into profits.

The speaker stated that one of the great problems in industry today is a decline in individual efficiency despite an increase in wage levels; and he suggested method improvements and careful use of labor-saving machinery as the only solution.

During the general portion of the meeting, the Erie Foundry Show of last June was recalled, as Chapter Director R. W. Griswold, Jr., Griswold Mfg. Co., Erie, presented a cash award to the winner of an essay contest on "Why I Would Like to Work in a Foundry." The successful contestant was Albert Kuhn, Erie high school student.

Chapter Outing

Gathering at Tiemann's Grove, Erie, on September 14, 110 foundrymen and friends enjoyed a day of good fellowship at the chapter picnic. Golfing, good food; horseshoes, an egg-throwing contest, and other games, as well as a pouring contest, were features of the event.

Arrangements for the picnic were handled by the entertainment committee, under chairmanship of William Bartals, Erie Malleable Iron Co.

Rochester

D. E. Webster
American Laundry Machinery Co.
Chapter Director

GUEST SPEAKER for the season-opening October 8 meeting of Rochester A.F.A. chapter, at the Hotel Seneca, Rochester, N. Y., was H. C. Winte, Worthington Pump & Machinery Corp., Buffalo, Chapter Chairman of Western New York chapter, who discussed gating and risering practice.

Mr. Winte went into detail in regard to the lengths and types of various gates and risers used in the foundry with which he is associated. He pointed out that the proper design and placing of gates and risers has a pronounced effect on cleanliness and soundness of the casting.

Foundrymen at the meeting also heard an eye-witness account of the atomic bomb demonstration at Bikini, from Herbert Mermagen, man-

ager, industrial x-ray division, University of Rochester. Mr. Mermagen was one of the group of scientists invited to witness the explosions; and he related his personal experiences and his predictions as to future applications of atomic energy.

St. Louis District

R. E. Woods
Warren Coke Co.
Chapter Secretary

SPIRITED EXCHANGE OF VIEWS marked the general discussion period following the technical session, at the October 10 meeting of St. Louis District A.F.A. chapter in the DeSoto Hotel, St. Louis. "Foundry Incentives" was the topic handled by D. C. Latella, Norris Elliott, Inc., Columbus, Ohio; and Chapter Chairman R. T. Leisk, American Steel Foundries, East St. Louis, Ill., presided.

Illustrating his points with slides, the speaker explained the operations of setting up a work day and establishing bonuses and wage incentives. Stating that the entire procedure was based upon time and motion studies, he contended that a good industrial engineer, even though not a foundryman, and unacquainted with foundry practices, was qualified to set up standards.

Exception to some of Mr. Latella's recommendations was taken by W. E. Illig, Banner Iron Works, St. Louis, when the meeting was thrown open for questions and discussion. The ensuing presentation of arguments raised many points of interest to foundrymen which had not been previously considered.

Prior to the technical session, R. L. Jones, American Steel Foundries, presented a paper on "Foreman Training" as the coffee talk at the dinner. Attendance for the evening was 110. Walter Zeis, Midwest Foundry Supply Co., Edwardsville, Ill., chairman of the chapter membership committee, introduced guests and a number of new members.

September Meeting Opens Season

A lively discussion period was also a feature of the season-opening September 12 meeting at the DeSoto Hotel, with 105 members and guests on hand to hear E. H. Schleede, United States Gypsum Co., Chicago, speak on "Gypsum Cement Pattern Making." Chapter Vice-Chairman N. L. Peukert, Carondelet Foundry Co., St. Louis, presided.

Considerable advance interest in the meeting had been indicated by reservation cards, and the turnout was considered a justification of the hopes of chapter officers and directors for a highly successful season.

Mr. Schleede presented a number of pictures to illustrate applications of cement in the foundry, and these, together with a number of displays, aroused the interest and comments of the foundrymen. Those present followed the speaker's remarks closely, and added their own observations during the question period.

Chicago

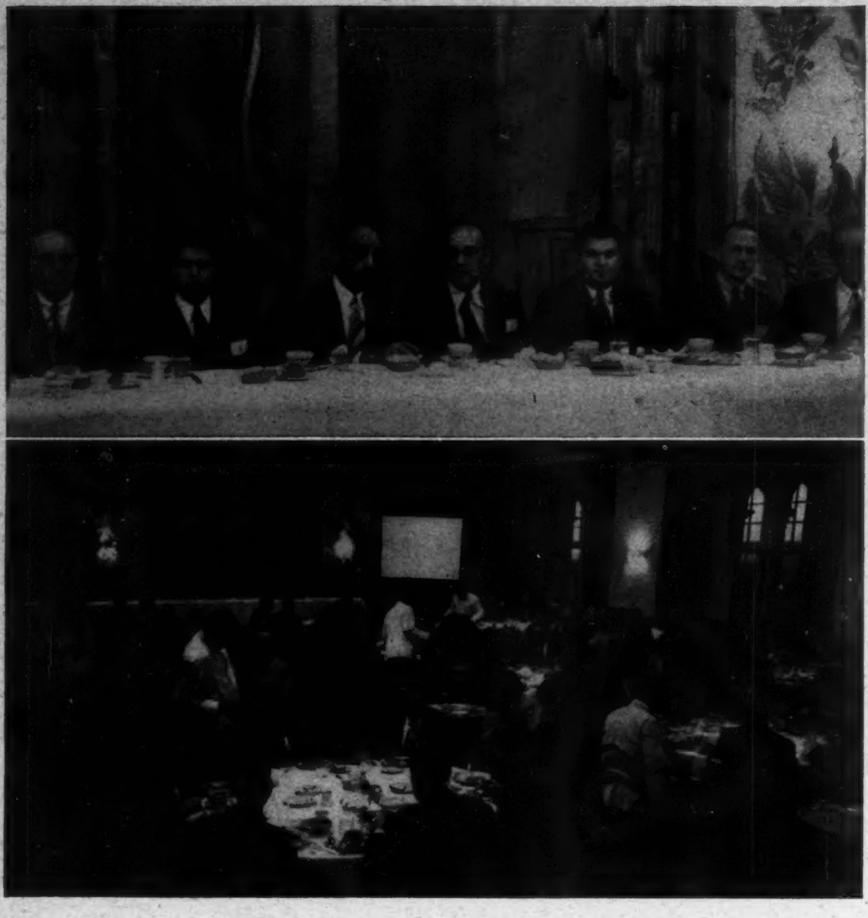
J. C. Lunkes
Velsicol Corp.
Chapter Secretary

PAST CHAIRMEN'S NIGHT was observed by 141 foundrymen and guests of Chicago A.F.A. chapter, in attendance at the Chicago Bar Association, October 7, for the first chapter meeting of the new season.

Present, and honored on the occasion, were these former chairmen of Chicago-area foundrymen: M. F. Becker, M. F. Becker & Associates, Chicago; H. W. Johnson, Wells Mfg. Co., Des Plaines, Ill.; A. S. Klopf, Lester B. Knight & Associates, Chicago; L. H. Rudesill, Griffin Wheel Co., of the same city; James Thomson, Continental Foundry & Machine Co., East Chicago, Ind.; C. E. Westover, Westover Engineers, Milwaukee, former A.F.A. Executive Vice-President; and L. J. Wise, Chicago Malleable Castings Co., Chicago.

Speaker of the evening was E. L. Berry, Link-Belt Co., Chicago, who spoke on "Job Evaluation." He highlighted his discussion with the assertion that management should

Scenes from Northeastern Ohio A.F.A. chapter's first meeting of the season, September 12 at the Cleveland Club. Upper right, speakers' table: Dr. R. L. Lee, General Motors Corp., Detroit, speaker of the evening, is fourth from left, seated between (left) Chapter President H. J. Trenkamp, The Ohio Foundry Co., and Chapter Vice-President Bruce Aiken, Crucible Steel Casting Co., both of Cleveland.
(Photos courtesy S. N. Farmer, Sand Products Corp.)



At the first meeting of the season for St. Louis District A.F.A. chapter (September 12 at the DeSoto Hotel, St. Louis): Bottom, general view of the attendance during the less technical phase of the evening; top, section of the speakers' table, fourth from left, speaker of the evening E. H. Schleede, development engineer, U. S. Gypsum Co., Chicago.

consider its investment in personnel as an asset, the same as it considers its investment in land, buildings and equipment.

During the dinner, the members were entertained by a group of singing foundrymen: L. W. Soldan, A. C. MacClure, T. E. Killeen, Jr., A. J. O'Donnell, E. Votana and R. W. Holding, Crane Co., Chicago.

Annual stag and outing of the Chicago A.F.A. chapter was held August 24 at the Lincolnshire Country Club, near Crete, Ill., and was marked by a record turnout of 1100.

Golfing foundrymen officially opened the gala event by teeing-off as daylight was poured, and continued down the fairways throughout the day, the last foursome teeing-off at 2:00 pm. Other games and entertainment, such as horseshoes and a boxing show, occupied those present, according to their individual preferences.

At the end of a day of labor, prizes were awarded and refreshments served under the big tent. A floor show rang down the curtain on the festivities.

The entertainment committee, 35 strong, was headed by B. A. Patch, Ohio Ferro-Alloys Corp., and H. E. Cullen, Carnegie-Illinois Steel Corp., both of Chicago.

Central Indiana

J. W. Giddens
International Harvester Co.
Chapter Reporter

Two GUEST SPEAKERS highlighted the October 11 dinner meeting of Central Indiana A.F.A. chapter, at the Antlers Hotel, Indianapolis, as a new chapter season was ushered in. Rodger Bronsen, Bronsen, Nennhy & Ulseth, Inc., Chicago, handled the main topic of the evening, "Safety in the Foundry," and George Applegate, Indiana Manufacturers' Association, led a short discussion on the Indiana Foundry Code as prepared by the state Department of Labor.

Ralph Thompson, Electric Steel Castings Co., Indianapolis, served as technical chairman.

Mr. Bronsen, who has spent the past ten years as an insurance man working for foundry safety, pointed out that foundries having high safety standards have less labor troubles.

Philadelphia

H. V. Witherington
H. W. Butterworth & Sons Co.
Chairman, Publicity Committee

CHAPTER OFFICERS envisioned a highly successful season ahead for Philadelphia A.F.A. chapter, as more than 200 members and guests gathered for the first meeting, October 11 at the Engineers' Club. E. H. Schleede, United States Gypsum Co., Chicago, presented a technical paper on plaster patterns; and Fred Liederback, Olney Foundry Div., Link-Belt Co., Philadelphia, served as technical chairman for the evening session.

W. B. Coleman, Philadelphia chapter's secretary-treasurer, W. B. Coleman Co., Philadelphia.

The speaker presented a thorough explanation of the development of plaster patterns, stressing use of the correct plaster for a particular job, as well as the methods for making basic patterns and assembling the completed pattern. His remarks were followed closely by the foundrymen, who raised many questions and demonstrated their interest in the subject during the brisk general discussion period.

FOUNDRY PERSONALITIES

C. H. Pomeroy, since 1938 a director, National Malleable & Steel Castings Co., Cleveland, and vice-president in charge of finances since 1944, succeeds the late **Charles H. McCrea** as president of the firm. Mr. Pomeroy will continue in the capacity of treasurer. He joined the firm in 1920 as credit manager, and advanced to assistant treasurer, treasurer and secretary and treasurer, before assuming the duties of vice-president in charge of finances.

J. Donald Zaiser, executive vice-president, Ampco Metal, Inc., Milwaukee, succeeds his father, the late C. J. Zaiser, as president of the firm, in a recent election. He entered the company as a member of the production department in 1933, moved to the field sales group the following year, and advanced to sales manager in 1938 and general manager last year.

M. K. Wells is president; **H. W. Johnson,** vice-president; **J. F. Duffy,** secretary, and **H. P. Wenzel,** foundry superintendent of Wells Mfg. Co., Des Plaines, Ill., a newly formed corporation which conducts operations at the former "Plant B" of the Chicago Foundry Co. Both Mr. Wells and Mr. Johnson have been A.F.A. members for many years, the latter having served as President of the Chicago chapter in 1937-38.

C. E. **Price,** who joined Peninsular Grinding Wheel Co., Detroit, 11 years ago as sales manager and later advanced to vice-president in charge of sales, was recently elected president of the firm.

R. M. **Arnold,** president, Arnold Engineering Co., Chicago, was recently elected a member of the board of directors, Allegheny Ludlum Steel Corp., Pittsburgh, which acquired the Arnold firm as a wholly-owned subsidiary this year.

P. **H. Desrosiers** has been elected executive vice-president and director, Joliette Steel, Ltd., Joliette, Que., recently acquired Canadian subsidiary of American Brake Shoe Co., New York, and operated by the American Manganese Steel Division of the latter firm. Well known in Canadian steel circles with which he has been associated since 1916 when he joined the Joliette firm, Mr. Desrosiers served that company as secretary-treasurer, sales manager and managing director, successively, leaving in 1932 to become associated with Sorel Steel Foundries, Ltd., Sorel, Que.

Directors of the new subsidiary are: **William Black,** president, American Manganese Steel Division; **J. B. Terbell,** president, Joliette Steel, Ltd., and executive vice-president of the Manganese division; **J. L. Mullin,** vice-president in charge of operations for U. S. plants of the same division; **T. E. Akers,** president, Canadian Ramapo Iron Works, Ltd.; and **M. N. Trainer,** first vice-president, American Brake Shoe Co.

C. W. Wade

F. J. Walls

A. L. Thurman, chief electrical engineer, Aetna-Standard Engineering Co., Youngstown, Ohio, advances to assistant to the vice-president; **James Riddell,** in the engineering department for the past eight years and recently assistant chief electrical engineer, to chief electrical engineer; and **William Rodder,** for the past eight years chief engineer, to director of engineering, in a series of appointments announced by the firm. **Perry Snyder,** until recently division engineer, Briar Hill Works, Youngstown Sheet & Tube Co., of the same city, moves to the Aetna-Standard firm as chief engineer, succeeding Mr. Rodder.

F. J. Walls, International Nickel Co., Detroit, A.F.A. National President for 1945-46, serves as a director of Engineering Castings, Inc., Marshal, Mich., a new specialty alloy castings firm organized by **A. E. Rhoads** and **D. W. Boyd,** both formerly associated, as executive vice-president and general manager and as manager of sales and service, respectively, with Detroit Electric Furnace Div., Kuhlman Electric Co., Bay City, Mich.

Mr. Rhoads becomes president of the new organization; and Mr. Boyd, works manager and secretary-treasurer. **Kenneth Loer,** service engineer with the Electric Furnace division, resigns that position to join Engineering Castings, Inc., as superintendent. All are A.F.A. members.

C. W. Wade leaves Caterpillar Tractor Co., Peoria, Ill., where he was supervisor of pattern shop and foundry training, to accept the position of superintendent, Indianapolis Brass Foundry, Indianapolis. Mr. Wade is known for his outstanding work in apprentice training programs and has served as Chairman, A.F.A. Apprentice Training Committee. He was also one of those instrumental in organization of Central Illinois A.F.A. chapter and served as Chapter Secretary of that group.

Burt Bevis succeeds Mr. Wade as supervisor of pattern shop and foundry training at Caterpillar.

J. D. Greensward, for the past three years assistant to the treasurer, Allis-Chalmers Mfg. Co., Milwaukee, was promoted recently to assistant to **W. C. Johnson,** vice-president of the general machinery division. Mr. Greensward has been with the firm since 1922.

W. E. Lewis, vice-president, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., assumes charge of

the new Chicago branch office, according to recent announcement by the firm.

R. E. Kennedy, A.F.A. Secretary Emeritus, has resumed his association with the University of Illinois, and is supervising instruction in foundry practice and patternmaking at the Navy Pier branch, Chicago. Mr. Kennedy, who relinquished the duties of Secretary and was named Secretary Emeritus by the A.F.A. Board of Directors in 1945, had taught foundry practice at the Urbana campus of the University from 1910 until joining the A.F.A. National Office staff in 1924.

B. E. Drury, Jr.

R. E. Kennedy

Brigadier General Edward B. McKinley has been named Commandant, Industrial College of the Armed Forces, succeeding **Brigadier General Donald Armstrong,** who retired July 1. General McKinley served in World War I, and later attended the Cavalry School at Ft. Riley, Kans.; Quartermaster School, Philadelphia; Army Industrial College, Washington, D. C.; Army War College, Washington, D. C.; and Harvard School of Business Administration, Cambridge, Mass. He brings to his present assignment a background which includes extensive experience in business administration on such assignments as purchasing and contracting officer, Schofield, Hawaii; Chief of the Fiscal Division, Office of the Quartermaster General; Deputy Vice-President of the Allied Commission in Italy; and Deputy Quartermaster General.

D. B. Phillips, foundry process engineer, Bendix Products Div., Bendix Aviation Corp., South Bend, Ind., moves to Lobdell-Emery Mfg., Alma, Mich., as foundry superintendent, in a new association.

W. Hessenberg of the British Non-Ferrous Metals Research Association in England was a recent visitor at the A.F.A. National Office. Mr. Hessenberg is in this country studying some administrative practices of non-ferrous foundries, on assignment by the British Government. His society has long played an active part in non-ferrous foundry work over seas.

B. E. Drury, Jr., assistant to the vice-president in charge of sales, Wilson Foundry & Machine Co., Pontiac, Mich., moved up to sales manager, in a recent promotion. A member of the Wilson organization since 1942, he was previously sales manager, R. H. Bingham Co., Detroit.

B. W. Schafer, travelling sales engineer for the past three years, advances to manager of sales and service and **C. V. Kilburn,** after seven years service as design engineer, moves up to assist in sales engineering in the field and becomes head of the research and engineering department, in appointments recently announced by Detroit Electric Furnace Div., Kuhlman Electric Co., Bay City, Mich.

J. F. Smith, general manager, Coyuga Cordage Mfg. Co., Auburn, N. Y., is engaged in business for himself, laying out ferrous and nonferrous production foundries. He leaves for Puerto Rico on his next assignment. Mr. Smith holds a Personal Membership in A.F.A., was formerly associated with Central New York chapter, and is now on the Metropolitan chapter roster.

L. W. Moncrief, for 26 years a metal patternmaker, and the last 10 years pattern shop foreman, with Stockham Pipe Fittings Co., Birmingham, resigned recently to operate his own general patternmaking business, and is now with M.B.C. Pattern Works, Birmingham.

D. L. Colwell, Chicago district manager, National Smelting Co., Cleveland, has been presented with the Navy Department's highest civilian recognition, the Distinguished Civilian Service Award, for "service well above the standards of most excellent accomplishment . . .," to quote, in part, the citation signed by the Secretary of the Navy.

C. W. Morisette, formerly associated with the Milwaukee Vocational School, recently joined Pennsylvania State College, State College, Pa., as assistant professor of industrial engineering. Mr. Morisette has been active in A.F.A. apprentice training activities as a member of the Subcommittee on the Apprentice Contest.

F. A. Mason resigns from Attwood Brass Works, Grand Rapids, Mich., to devote more time to his partnership and obligations as adviser and consultant in Foundry Service Engineers, and his partnership and sales engineering duties with Grand Rapids Foundry Supply House, both of Grand Rapids. Mr. Mason has an extensive background in non-ferrous casting, is also familiar with gray iron practices, and has written on heat treatment of bronze castings for the trade press. He is a member of Western Michigan A.F.A. chapter.

W. E. Buckler has established the Buckler Foundry Co., East Alton, Ill., and is installing equipment for the manufacture of gray iron castings. Mr. Buckler was formerly associated as foundry superintendent with Deere & Co., Moline, Ill., and Allis-Chalmers Mfg. Co., Milwaukee.

H. F. McVay, formerly superintendent, Manila Power Co., Manila, P.I., who spent three years in Santo Tomas prison camp, has returned to this country as general manager in charge of production, The Delhi Foundry Sand Co., Cincinnati.

Ned Landis, having served for five years with the U. S. Navy, rejoins Allis-Chalmers Mfg. Co., Milwaukee, and succeeds **L. R.** Reid as manager, Syracuse, N. Y., office, according to announcement by **J. L. Singleton,** company district offices manager. Mr. Reid is now associated with the electrical department of the firm's main works.

(Continued on Page 98)

NEW LITERATURE

Corrosion and contamination control problems are considered in an 8-page technical bulletin, "Coating Comparison Chart," prepared by Amercoat Div., American Pipe & Construction Co., P. O. Box 3428, Terminal Annex, Los Angeles 54. Information concerning the entire Amercoat line is presented in a form streamlined for ready reference, and suitable as a guide for selection of proper coating, surface preparation and application method.

New data on colloidal graphite and its applications, which include coating ladles and spraying dies and molds, are offered in a technical booklet available from Acheson Colloids Corp., Port Huron, Mich.

Technical articles on "Sodium Hydride Descaling," concerned with experiences of a steel mill in descaling in a salt bath furnace, and "Sodium Hydride Descaling and Desanding of Ferrous Castings and Forgings," dealing with special application of the process to iron castings and forgings, are available from Ajax Electric Co., Inc., Philadelphia 23.

Two new silicone diffusion pump fluids are described in a new pamphlet issued by Dow Corning Corp., Midland, Mich. The fluids are said to be suitable for use in metal evaporator systems. Refer to "Silicone Fluids DC 702 and 703."

Air-Hydraulics, Inc., 120 W. Middle St., Chelsea, Mich., presents an 8-page catalog, describing the firm line of air-hydraulic presses: features and applications.

Platform and fork models of electrical industrial lift trucks, manufactured by Automatic Transportation Co., 149 West 87th St., Chicago 20, are introduced in a new three-color, 8-page brochure, "The Transtacker." Attractive presentation includes sketches and photographs of operation and construction; line drawings depicting dimensional specifications, weights and load capacities, and sketches of applications.

Detailed description of the new "Pyro Immersion Pyrometer" is available in Catalog No. 150, Pyrometer Instrument Co., 103 Lafayette St., New York 13. Such features as interchangeable thermocouples are outlined, and specifications are listed.

Filter for process operations, "Conkey Rotary Disc Vacuum Filter," is presented in Bulletin No. 102, issued by General American Process Equipment Div., General American Transportation Corp., 420 Lexington Ave., New York 17. Applications, operation, construction, specifications of various models, and auxiliary equipment are discussed.

Description of a solder classified as "unique," is given in a 4-page bulletin by Alpha Metals, Inc., 359 Hudson Ave., Brooklyn 1, N. Y. The product, "Tri-Core," is a self-fluxing solder, with three cores of rosin located beneath the surface of the metal, and designed to prevent production slowdown by assuring a continuous flow of flux.

Transicoil Corp., 114 Worth St., New York 13, offers a 2-page bulletin describing its remote control "Servo Motor." Features of the unit are highlighted and a performance chart included.

Surface pyrometers—roll, extension, mold and needle—by Cambridge Instrument Co. Inc., 3137 Grand Central Terminal, New York 17, are shown and described in the firm's recent Bulletin 194-SA. Typical applications, specifications, scale ranges and combination and special models are considered.

Temperature control through the "Xactline Straight Line Temperature Control" unit, offered by Claud S. Gordon Co., 3000 S. Wallace St., Chicago 13, is portrayed in a 4-page color bulletin. Features are detailed, and specifications and price incorporated.

"This Is Hendy," a 66-page, ring-bound booklet, presents the story of Joshua Hendy Iron Works, Sunnyvale, Calif., in a pictorial history, stretching from the days of the "Gold Rush" to the present. Facilities, methods, products, of the firm, are shown and discussed in the unusually attractive booklet.

"Simplified Photomicrography with a Hand Camera," an eight page booklet describing a method of obtaining satisfactory photomicrographs with minimum investment in equipment, is available from Eastman Kodak Co., Rochester 4, N. Y. Optical considerations, focusing the camera, centration, magnification, disadvantages, apparatus and setup, and directions are presented in detail.

Discussion of "X-Ray as a Foundry Control Tool" is available from North American Phillips Co. Inc., 100 East 42nd St., New York 17. Four-page folder, a short technical paper by George Mullowney, industrial radiologist with the firm, considers production of x-rays, operational and equipment costs, and details of application.

The Bristol Co., Waterbury 91, Conn., announces Bulletin No. S1400, a 12-page discussion of the firm's tachometers: potentiometer type, millivoltmeter type, indicating and strip-chart recording. Wiring diagrams, application data and a typical installation, are given.

Third revised edition of "Kodak Data Book on Formulas and Processing" has been announced by Eastman Kodak Co., Rochester 4, N. Y. A number of changes have been incorporated to bring up to date the

(Continued on Page 107)

★ NEW A. F. A. MEMBERS ★

(Covering the period from September 15 to October 15)

● Twenty-seven chapters have sent in to the National Office the applications of 219 new members and three conversions. Looking back over the membership records, during the same period of time last year twenty-three chapters reported 102 new members with Saginaw Valley enrolling 13 names. This month Wisconsin heads the list with 26 names, while Saginaw netted 23 and two chapters, Central Illinois and Quad City, tallied 14 each.

Conversion—Company to Sustaining.

**Greenlee Bros. & Co., Rockford, Ill. (F. E. Rundquist, Fdry. Mgr.).

Conversion—Personal to Company.

*American Brake Shoe Co., American Manganese Steel Div., New Castle, Del. (W. N. Banks).

*Vassar Electroloy Products, Inc., Vassar, Mich. (Kenneth H. Priestley, Met.).

CANTON DISTRICT CHAPTER

Alfred S. Abegglen, American Steel Foundries, Alliance, Ohio.
Douglas V. Hamilton, Sales Mgr., Exothermic Alloys Sales & Service, Inc., Massillon, Ohio.
Ted E. Hofmann, Salesman, Exothermic Alloys Sales & Service, Inc., Massillon, Ohio.
Douglas D. Tipton, Salesman, Exothermic Alloys Sales & Service, Inc., Massillon, Ohio.

CENTRAL ILLINOIS CHAPTER

Albert Boerckel, Caterpillar Tractor Co., Peoria, Ill.
Frank Burketta, Core Room Foreman, Caterpillar Tractor Co., Peoria, Ill.
Albino F. Delmastro, Fdry. Appr., Caterpillar Tractor Co., Peoria, Ill.
R. H. Hinson, Cleaning Room Fore., Caterpillar Tractor Co., Peoria, Ill.
R. E. Hodgson, General Fore., Caterpillar Tractor Co., Peoria, Ill.
G. L. Martin, Purchasing, Caterpillar Tractor Co., Peoria, Ill.
Norwood Martin, Sub-Foreman, Caterpillar Tractor Co., Peoria, Ill.
John L. McMillan, Fdry. Planning, Caterpillar Tractor Co., Peoria, Ill.
Donald R. Sevier, Fdry. Appr., Caterpillar Tractor Co., Peoria, Ill.
Richard G. Sims, Fdry. Production, Caterpillar Tractor Co., Peoria, Ill.
Joseph Slater, Cleaning Room Fore., Caterpillar Tractor Co., Peoria, Ill.
Walter E. Walz, Insp. Supv., Caterpillar Tractor Co., Peoria, Ill.
F. Wolgamott, Maintenance Supt., Caterpillar Tractor Co., Peoria, Ill.
A. W. Young, Inspection, Caterpillar Tractor Co., Peoria, Ill.

CENTRAL INDIANA CHAPTER

Raymond Brookshire, Fore., Melting and Pouring, The Perfect Circle Co., New Castle, Ind.
Donald Bryant, Fore., Melting and Pouring, The Perfect Circle Co., New Castle, Ind.
Walter Grunden, The Perfect Circle Co., New Castle, Ind.
Lawrence Hudson, Fore., Melting and Pouring, The Perfect Circle Co., New Castle, Ind.
Charles R. Jones, Fore., Melting and Pouring, The Perfect Circle Co., New Castle, Ind.
Norman C. Kottkam, Ass't. Supt., Langsenkamp & Wheeler Brass Works, Indianapolis.
Ralph Lorton, The Perfect Circle Co., New Castle, Ind.
Howard Moschel, Fore., Melting and Pouring, The Perfect Circle Co., New Castle, Ind.
Robert C. Myers, Process Engr., The Perfect Circle Co., New Castle, Ind.
Roy A. Schmaltz, Langsenkamp & Wheeler Brass Works, Indianapolis.
George W. Vogel, Partner, American Air Filter Co., Louisville, Ky.

CENTRAL NEW YORK CHAPTER

Wallace W. Latham, Met., Corning Glass Co., Corning, N. Y.

CHESAPEAKE CHAPTER

James Baxter, Supervisory Trainee, Landis Machine Co., Waynesboro, Pa.
W. E. Biddison, Met., Chambersburg Engineering Co., Chambersburg, Pa.

CHICAGO CHAPTER

A. P. Alexander, Met., International Harvester Co., Chicago.
Bernard A. Annis, Engr., Lester B. Knight & Associates, Inc., Chicago.
Albert P. DiGirolamo, Fore., Chicago Steel Foundry Co., Chicago.
Wm. H. Fellows, Abrasive Engr., Bay State Abrasive Products Co., Westboro, Mass.
Edward S. Frye, Met., Assn. of Mfrs. of Chilled Car Wheels, Chicago.
Wesley Kingery, Valve Fore., Hammond Brass Works, Hammond, Ind.
Walter A. Kos, Machine Specialist, Crane Co., Chicago.
Harold W. Johnson, Vice-Pres., Wells Mfg. Co., Des Plaines, Ill.
Robert E. Williams, Furnace Fore., Hammond Brass Works, Hammond.
Stan J. Woods, Pattern Engr., Industrial Pattern Works, Chicago.

CINCINNATI DISTRICT CHAPTER

Burt A. Genthe, Mgr., The S. Obermayer Co., Cincinnati.
C. W. Gullickson, Sales Repr., Sterling Wheelbarrow Co, Milwaukee.
Richard B. Kling, Asst. Fdry. Supt., National Lead Co., Cincinnati.
Edward V. Leach, Personnel Mgr., Ohio Stove Co., Portsmouth, Ohio.

DETROIT CHAPTER

Frank Bacon, Charge Tech., Aluminum Co. of America, Detroit.
Eugene L. Buchman, Engr., Ford Motor Co., Dearborn, Mich.
Carl H. Engel, Met., Aluminum Co. of America, Detroit.
John Grahovac, Supt., Roberts Brass Mfg. Co., Detroit.
Francis Maze, Fore., Acme Foundry Co., Detroit.
Walter Peskey, Fore., Acme Foundry Co., Detroit.
John Herbert Robinson, Allmet Industries Pty., Ltd., Sydney, N. S. W., Australia.

EASTERN CANADA & NEWFOUNDLAND CHAPTER

Samuel Aboud, Mgr., St. Maurice Valley Appliances Ltd., Grande Mere, Que.
Russell W. Birrell, Core Room Fore., Warden King Ltd., Montreal, Que.
Lionel Blanchette, Crane Ltd., Montreal, Que.
Frank N. Land, Sand Tech., Crane Ltd., Montreal, Que.
Laurence Lambton Love, Salesman, Railway & Power Engineering Corp. Ltd., Montreal, Que.
William P. Sullivan, Met. Lab. Supv., Warden King Ltd., Montreal, Que.
J. W. Tutty, Dominion Wheel & Foundries Ltd., Toronto, Ont.

METROPOLITAN CHAPTER

Clifford M. Apgar, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
Robert R. Blackman, The International Nickel Co., Inc., Bayonne, N. J.
C. F. Colburn, Mgr., Roselle Foundry Co., Roselle Park, N. J.
James F. McQuillan, Supt., American Smelting & Refining Co., Barber, N. J.
*Roselle Foundry Co., Roselle Park, N. J. (Leon a Marantz, Pres.).
E. W. Rix, Supt., M. H. Detrick Co., Newark, N. J.
Howard E. Voit, Salesman, Sterling Wheelbarrow Co., New York.

MEXICO CITY CHAPTER

Solana G. Fernando, Mgr., Fundidora La Conception S. de R. L. Puebla, Pue.
Daniel Vareta, Ferroesmalte J. A. Guadalupe, Mexico D. F.

MICHIANA CHAPTER

*Acme Pattern Works, Inc., Elkhart, Ind. (Virgil A. Miller, Pres.).
Harold Clingenpeel, Fore., Dalton Foundries, Inc., Warsaw, Ind.
Alfred J. Hebert, Acme Pattern Works, Inc., Elkhart, Ind.
Kenneth Palmer, Production Fore., Dalton Foundries, Inc., Warsaw, Ind.
Joseph S. Tavernier, Owner, Elkhart Metal Products, Elkhart, Ind.
Alexander R. Troiano, Prof. of Met., University of Notre Dame, Notre Dame, Ind.
Richard G. Wiest, Quality Control Engr., Dalton Foundries, Inc., Warsaw, Ind.

NORTHEASTERN OHIO CHAPTER

Wm. W. Clark, III, Asst. Supv., Ferro Machine & Foundry Co., Cleveland.
James R. Quarrie, Asst. Supv., Ferro Machine & Foundry Co., Cleveland.
Richard J. Martin, Asst. Supv., Ferro Machine & Foundry Co., Cleveland.
Charles Seelbach, Jr., Plant Engr., The Forest City Foundries Co., Cleveland.
Ralph Strangward, Purch. Agent, The Forest City Foundries Co., Cleveland.
Henry Thacker, Gen. Fore., National Bronze & Aluminum Foundry Co., Cleveland.

**Sustaining Members.
*Company Members.

NORTHERN CALIFORNIA CHAPTER

C. E. Beckett, Sales, Gladding, McBean & Co., San Francisco.

***Gladding, McBean & Co., San Francisco (Arthur B. Morse, Sales Mgr.).**

Robert H. Walpole, Jr., Sales Engr., American Air Filter Co., Inc., Louisville, Ky.

A. E. Weidenbacker, Sales, Gladding, McBean & Co., San Francisco.

Ray F. Wimer, Sales, Gladding, McBean & Co., San Francisco.

NO. ILLINOIS & SO. WISCONSIN CHAPTER

R. D. Baysinger, Owner, Iron Star Foundry, Rockford, Ill.

Raymond Dryoel, Fdry. Fore., Geo. D. Roper Corp., Rockford, Ill.

Avery Hayes, Fdry. Fore., Gunite Foundries Corp., Rockford, Ill.

Lylanid J. Larson, Timestudy Engr., Gunite Foundries Corp., Rockford, Ill.

Thomas Tucker, Fore., Geo. D. Roper Corp., Rockford, Ill.

NORTHWESTERN PENNSYLVANIA CHAPTER

Charles N. Emling, Timestudy Tech., Erie Malleable Iron Co., Erie, Pa.

ONTARIO CHAPTER

Geo. S. Duncan, Met., Aluminum Laboratories Ltd., Kingston, Ont.

Dr. G. S. Farnham, International Nickel Co. of Canada, Ltd., Toronto, Ont.

Ernie D. Fulton, Jr., Salesman, Webster & Sons, Toronto, Ont.

Edwin C. Hergott, Owner, Herrgott Thresher Co., St. Clements, Ont.

***International Nickel Co. of Canada, Ltd., Toronto, Ont. (K. H. J. Clarke).**

T. Lyons, Empire Brass Mfg. Co. Ltd., London, Ont.

***Toronto Foundry Co., Ltd., Toronto, Ont. (George R. Winkworth, Mgr.).**

OREGON CHAPTER

Lawrence R. Buckner, Electric Steel Foundry Co., Portland.

Dave M. Haldeman, Patternmaker, Peerless Pattern Works, Portland.

Wm. F. Helber, Inspector, Electric Steel Foundry Co., Portland.

W. B. Kirby, Engr., Electric Steel Foundry Co., Portland.

Robert W. Mikkalo, Patternmaker, Peerless Pattern Works, Portland.

Kenneth S. Ronne, Partner, Northwest Pattern Works, Portland.

Arthur Schlotthaurr, Foreman, Electric Steel Foundry Co., Portland.

PHILADELPHIA CHAPTER

Lewis B. Kramer, Melter, Chester Electric Steel Co., Chester, Pa.

Frank E. Smith, Sales & Service Engr., Vesuvius Crucible Co., Pittsburgh.

Samuel Stewart, Foreman, Pattern Shop, The Autocar Co., Ardmore, Pa.

QUAD-CITY CHAPTER

***Geo. M. Beals, Supt., Universal Foundry Co., Cedar Rapids, Iowa.**

W. R. Brainard, Owner, Brainard & Co., Moline, Ill.

N. D. Coover, Asst. Sec'y., Swanson Foundry Co., Moline, Ill.

W. T. Ellison, Fore., Fairbanks, Morse & Co., East Moline, Ill.

Robert F. Grau, Deere & Mansur Works, Moline, Ill.

L. W. Ingersoll, Supt., Iowa Malleable Iron Co., Fairfield, Iowa.

Leslie W. Johnson, Engr., Deere & Mansur Works, Moline, Ill.

Willard H. Johnson, Sales Engr., Jerry Means Mfgrs. Agent, Rock Island, Ill.

Vincent B. Koprucki, Gen. Fore., The Bettendorf Co., Bettendorf, Iowa.

Joe McLean, S & W Corp., Bettendorf, Iowa.

George S. Reed, Owner, Reed Aluminum Foundry, East Moline, Ill.

Edward Root, Fore., Swanson Foundry Co., Moline, Ill.

***S & W Foundry Corp., Bettendorf, Iowa. (Russell H. Swartz, Gen. Fore.).**

***Swanson Foundry Co., Moline, Ill. (John C. Swanson, Pres.).**

SAGINAW VALLEY CHAPTER

***The Acme Pattern Co., Inc., Flint, Mich. (Harold E. Dennee, Pres.).**

John W. Anderson, Fore., Dow Chemical Co., Bay City, Mich.

***Big Rock Plow Co., Chesaning, Mich. (Louis Bila, Owner).**

Robert L. Bila, Big Rock Plow Co., Chesaning, Mich.

John S. Boruszewski, Fore., Baker Perkins, Inc., Saginaw, Mich.

Raymond Bowen, Supt., Supreme Gas Burner & Mfg. Co., Holly, Mich.

Alex. Ebel, Fore., Chevrolet Grey Iron Foundry Div., General Motors Corp., Saginaw, Mich.

Raymond E. Goodall, General Foundry & Mfg. Co., Flint, Mich.

Waldo Gusie, Supt. & V.P., The Acme Pattern Co., Inc., Flint, Mich.

Bruce W. Hemingway, Cupola Fore., General Foundry & Mfg. Co., Flint, Mich.

Alfred J. Kunz, Vice-Pres., Vassar Electroloy Products, Inc., Vassar, Mich.

Fred Kuschnereit, Molding Fore., Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich.

Clarence McLean, Fore., General Foundry & Mfg. Co., Flint, Mich.

Earl L. McCoy, Maint. Supt., Chevrolet Grey Iron Foundry Div., General Motors Corp., Saginaw, Mich.

Wm. A. Nelson, Fore., Buick Motor Co., Flint, Mich.

Otto J. Nickodemus, Treas., Vassar Electroloy Products, Inc., Vassar, Mich.

Ralph Russell, Fore., General Foundry & Mfg. Co., Flint, Mich.

Edward A. Salow, Fore., Baker Perkins, Inc., Saginaw, Mich.

E. L. Schaper, Supt. Die Casting, Magnesium Div., Dow Chemical Co.

Fred Serr, Pattern Shop Supv., General Foundry & Mfg. Co., Flint.

A. James Walker, Student, General Motors Institute, Flint, Mich.

Joseph E. Winston, Mgr., City Pattern & Eng. Co., Flint, Mich.

R. S. Wood, Core Fore., Dow Chemical Co., Bay City, Mich.

ST. LOUIS DISTRICT CHAPTER

Charles S. Ban, Special Appr., American Brake Shoe Co., St. Louis, Mo.

Robert G. Carlson, Special Appr., American Brake Shoe Co., St. Louis, Mo.

Don R. Deal, Plant Engr., U. S. Radiator Corp., Edwardsville, Ill.

George Jordan, Gen. Fdry. Fore., American Steel Foundries, East St. Louis, Ill.

D. C. Latella, Prof. Eng., Norris & Elliott, Inc., Columbus, Ohio.

Charles E. Pynchon, Jr., Special Appr., American Brake Shoe Co., St. Louis, Mo.

Robert V. Simpson, Special Appr., American Brake Shoe Co.

Robert F. Walsh, Special Appr., American Brake Shoe Co., St. Louis, Mo.

SOUTHERN CALIFORNIA CHAPTER

***Compton Foundry, Compton, Calif. (James Barr, Pres. & Gen. Mgr.).**

Clinton Cook, Foundry Fore., General Metals Corp., Los Angeles.

Norman H. Feinberg, Owner-Mgr., Industrial Materials & Metal Co., Los Angeles.

Willard E. Fields, Pttn. Engr., Western Gear Works, Lynwood, Calif.

Harold N. Jameson, Met., Los Angeles Steel Casting Co., Los Angeles.

Willard C. Klick, Allied Castings Co., Los Angeles.

Keller Phillippe, Melters Helper, Los Angeles Steel Casting Co., Los Angeles.

***Quality Foundry, Los Angeles. (Charles Handova, Supt.).**

Ernest J. Schenckl, Patternmaker, Kinney Iron Works, Inc., Los Angeles.

Osborne J. Stoudt, Fdry. Engr., Brumley-Donaldson Co., Huntington Park, Calif.

W. A. Towers, Snyder Foundry Supply Co., Los Angeles.

TEXAS CHAPTER

***Martin Smith Co., Houston. (W. B. Stever, Chief Engr.).**

***Western Foundry Co., Tyler. (Isreal Smith, Pres.).**

TWIN-CITY CHAPTER

Gordon Atherton, Supt., South Park Foundry & Mfg. Co., St. Paul, Minn.

Perry D. Goldberg, Met., South Park Foundry & Mfg. Co., St. Paul.

Henry Orme Lackore, Supt., Washington Foundry Co., St. Paul, Minn.

Clifford E. Rucker, Office Mgr., South Park Foundry & Mfg. Co., St. Paul, Minn.

Sidney S. Silberg, Met., South Park Foundry & Mfg. Co., St. Paul, Minn.

WESTERN NEW YORK CHAPTER

D. F. Brookland, Met., Vanadium Corp. of America, Niagara Falls.

DeWitt G. Kittinger, Salesman, Abrasive Shot & Grit Co., Springville.

H. Wm. McAvay, Buffalo Pipe & Foundry Co., Buffalo.

Harry E. Orr, Mgr., Vanadium Corp. of America, Niagara Falls.

Howard C. Parkman, Supt. of Reduction, Vanadium Corp. of America, Niagara Falls.

WISCONSIN CHAPTER

Louis A. Allen, Wisconsin Grey Iron Foundry Co., Milwaukee.

Leonard E. Brooks, Purchasing Agent, International Harvester Co., Waukesha.

Geo. W. Bulin, Supt., Wisconsin Pattern Works, Inc., Racine.

James E. Burke, Vice-Pres., Wisconsin Grey Iron Foundry Co., Milwaukee.

Warren J. Carlin, Core Room Fore., Wisconsin Grey Iron Foundry Co.

Thomas J. Donlan, Supt., Standard Foundry Co., Racine.

Wilfred W. Eberhardy, Maintenance Engr., Wisconsin Grey Iron Foundry Co., Milwaukee.

John J. Elko, Timestudy Fore., Allis-Chalmers Mfg. Co., Milwaukee.

Earl W. Engstrom, Asst. Fdry. Met., International Harvester Co.

Clarence M. Hansen, Wisconsin Pattern Works, Inc., Racine.

Fred G. Hill, Supv. Sand Treatment, Kohler Co., Kohler.

Harry W. Hoffmann, Sales Repr., Allis-Chalmers Mfg. Co., Milwaukee.

Chet T. Horton, Engr., Metal & Thermit Corp., Chicago.

Kenneth L. Jacobs, Met., Standard Brass Works, Milwaukee.

Fred E. Katzenski, Gen. Fore., International Harvester Co., Waukesha.

Raymond E. Kelm, Office Mgr., Whitewater Mfg. Co., Whitewater.

Gilbert E. Kempka, Student, University of Wisconsin, Milwaukee.

Otto Lehmann, Fore., Metal Dept., Wisconsin Pattern Works, Inc., Racine.

Carl H. Litt, Fore., International Harvester Co., Waukesha.

Louis Mueller, Supt. Wisconsin Grey Iron Foundry Co., Milwaukee.

Alfred Sawejka, Supt., West Allis Grey Iron Foundry Co., Milwaukee.

Milton A. Stoffel, Fore., Wood Dept., Wisconsin Pattern Works, Racine.

Sigmund S. Szymanski, Fore., Zenith Foundry Co., West Allis.

William F. Steffen, Fdry. Fore., Wisconsin Grey Iron Foundry Co., Milwaukee.

***Whitewater Mfg. Co., Whitewater. (Robert J. Stevenson, Pres.).**

***Wisconsin Pattern Works, Inc., Racine. (R. J. Christensen, Pres.).**

*Company Members.

NEW PRODUCTS

Drill Press Converter

Leo G. Brown Engineering Co., Los Angeles, announces a new unit through which any size drill press can be adapted for filing, cutting, sawing or slotting operations. Incorporating only three moving parts,

the mechanism converts drill press rotary action to a vertical reciprocating action through a steel cam mounted between pre-loaded ball bearings. Drill press power output is reported increased approximately 300 per cent. Available in 1- and 1¾-in. stroke models.

Lift Truck

Lewis-Shepard Products, Inc., Watertown, Mass., has perfected a new 4,000-lb. capacity electric power fork truck, featuring an extremely low center of gravity; minimum overall length from back of truck to point of 48-in. fork; and a short turning radius. Carrying a 48-in. load, this truck can enter an aisle 12 ft. wide and, in continuous forward travel, make a single right angle turn and right angle stack without backing or filling.

Carbide Tipped Drill Bits

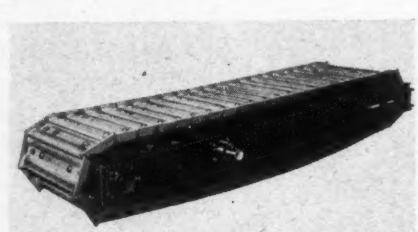
New England Carbide Tool Co., Cambridge, Mass., has announced a line of "Cyclone Drill-Bits," suitable for use in any standard electric rotary drill and designed for high speed, economical operation. Bits are said to drill holes from 50 to 75 per cent faster and outwear conventional steel drills 50 to 1; and are recommended by the company for drilling cast irons, aluminum and other nonferrous materials, as well as concrete, brick, wall tile, and general masonry. Circular listing specifications and prices is available on request.

Finish Component

Dow Corning Corp., Midland Mich., announces DC 804, a new silicone resin for formulating heat resistant paints. Exceptional resistance to moisture, oxidation, ozone and ultra-violet radiation are claimed for the resin, said to be especially indicated for use in formulating white finishes with properties between those of ceramic coatings and ordinary organic paints.

Conveyor Unit

Chain Belt Co., Milwaukee 4, announces the production of a completely self contained, factory assembled heavy duty apron conveyor unit. Roller supported apron feeder is furnished in several widths and with centers ranging from a mini-



mum of 4 ft.-7 in. to a maximum of 9 ft.-1 in., varied by 18-in. increments. Designed for reduced power consumption and longer belt life, unit features heavy steel chain belt riding directly on large diameter traction rollers.

Two-Ton Hoist

Yale & Towne Mfg. Co., Philadelphia 24, have added a new model, of two-ton capacity, to their line of "Midget King" electric hoists. Available with hook for stationary use and permanently attached trolley for use on overhead track, the unit also features load brake and motor brake operating whether power is on or off; precision bearings throughout; flip of the wrist control on lowering and lifting action, through one-hand bargrip which leaves hoist operator with one free hand to guide load; safety stops to prevent overtravel of hook; and special steel hook reported to yield slowly without fracture under overload, before any other part of hoist is strained to yield point.

Welding Rod

Eutectic Welding Alloys Corp., New York, has developed an improved flux-coated welding rod for welding gray and alloy cast irons at low temperature. Flux-coated "EutecRod 14" can be applied at an average temperature of 1450° F. in the weld area; flux is applied continuously during work; and metallic alloying elements are contained in the coating.

Inside-Bore Micrometer

Tubular Micrometer Co., St. James, Minn., offers a new precision measuring device for determining bore sizes over or around center obstructions. The new tubular, over-the-bar inside micrometer can measure inside diameters of bores without necessity of removing the boring bar, which would disturb cutter settings and entail extra work. Hollow-box type steel frames feature rigidity of tubular construction, plus lightness in weight. Available in range of sizes covering diameters from 4 to 8 in. Provi-

sion is made for adjustment for wear, in order to assure constant accuracy and alignment.

Corrosion Resistant Finish

Rheem Research Products, Inc., Baltimore 2, Md., has added an "Iridite Bright" process, to produce brilliance and corrosion resistance on zinc and cadmium plate, to the line of chemical finishes marketed by the firm. Process requires no electric current; parts are dipped for five seconds only, followed by usual rinsing and drying; and laboratory tests of treated zinc panels are reported to reveal no sign of corrosion after 100 hours exposure to salt spray.

Boring Machine Attachment

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., announces a continuous-feed facing and boring head, designed to simplify a variety of operations, such as; boring, turning, grooving, recessing and threading, which are difficult to handle on ordinary equipment of horizontal boring machines. Suitable for application on all types of the firm's horizontal boring machines, the attachment may be mounted on the spindle sleeve of the headstock or, with suitable adaptor, on a line boring bar. In the latter case, machining of hard to reach surfaces is reported greatly simplified.

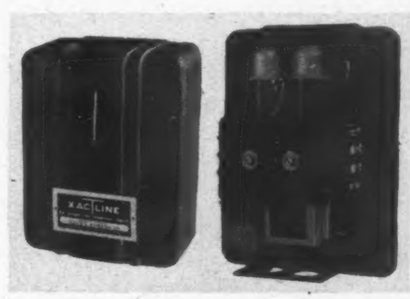
Induction Heater

Induction Heating Corp., 389 Lafayette St., New York 3, introduces Model "1400," newest, largest and most versatile in the firm

line of "Ther-monic" high-frequency induction heating generators. The unit is designed for use in brazing, soft soldering, and fusing, as well as hardening, annealing, tempering, stress relieving, forging, melting, shrink fitting, debonding and expanding. Operates on 205-245 volt, 60 cycle, three-phase power supply. Provision is made for reducing 440-550 voltages, common to many plants, to 220 volts through installation of a transformer. Maximum output is 1400 Btu. per minute, or approximately 25 kw. at a nominal frequency of 375 kilocycles.

Temperature Control Unit

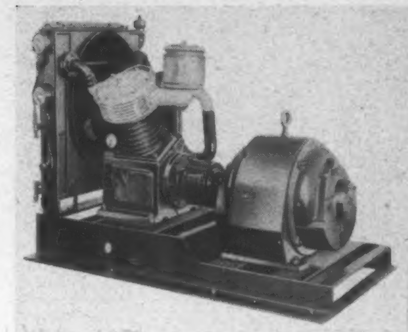
Claud S. Gordon Co., 3000 S. Wallace St., Chicago 16, announces its new "Xactline" temperature control, designed to prevent costly



overshoot and undershoot temperature variations in heat processes. Variation as low as 1/5 degree F. and power 'on-off' cycles as short as three seconds, have been attained, the company reports. Unit is suitable for all types of electric furnaces, ovens, injection molding machines, etc., employing conventional millivoltmeter and potentiometer type controlling pyrometers, or gas-fired equipment employing solenoid-controlled or motor-operated valves. 'Straight line' temperature control without complicated co-ordination with other equipment is claimed. No cams, motors, bearings shafts, gears or other rotating parts are used.

Air Compressor

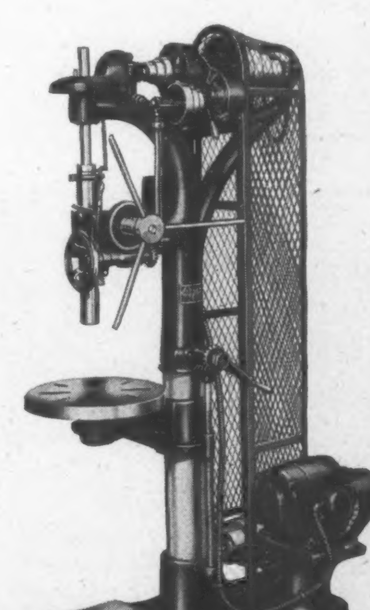
Davey Compressor Co., Kent, Ohio, outlines a new plan for air compressor installation with the announcement of a line of "Departmental" compressors, available in varying capacities for the requirements of individual sections of the



plant. Units are designed to operate independently, supplying the needs of specific departments; but several are to be connected together to provide a power reserve for over-peak loads or maintain service in event of breakdowns.

Drilling Machine

Sibley Machine & Foundry Corp., South Bend, Ind., presents a new 20-in. drilling machine, especially designed for drilling up to 1¼-in. in cast iron, or the equivalent in other metals. Unit is equipped with motor drive and belt guard, or tight and loose pulley drive where operation is to be from a line shaft. Both power and hand feed are furnished. Drill table rotates on an arm which swings on the column (see cut) in order to provide maximum working space. Table is held at right angle to spindle within close tolerance. Rotary geared coolant pump and geared tapping attachment are available.



FIRM FACTS

Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., announces opening of a Chicago branch office at 309 N. Michigan Ave. The office, equipped to handle sales and service, will be in charge of W. E. Lewis, firm vice-president.

Centrifugal Foundry Co., Muskegon Heights, Mich., has been incorporated with a capitalization of $625,000 and a change in firm name from the original **Centrifugal Castings Co.,** established in 1943.

Sandberg & Sons, 4204 Second Ave., Moline, Ill., have acquired a permit for construction of a foundry, 44x60 ft., at an estimated cost of $6500.

Sale of **Ordnance Steel Foundry,** Bettendorf, Iowa, to **Bettendorf Co.,** of that city, has been approved by the War Assets Administration, according to announcement of W. E. Bettendorf, president of the firm.

Automatic Transportation Co., Chicago, recently consigned 24 of its battery-driven motorized "Transporter" hand trucks to its distributor, Mauricio Litman, Buenos Aires, Argentina, in what was called the largest commercial shipment of motorized hand trucks ever sent to a foreign market. The "Trans-

porter" units are among several types of the firm's material handling equipment reported as being adapted by Argentine industry to mechanization of its movement of materials. Automatic Transportation Co. advises that carload lots of its other products, including fork trucks, tractors, etc., will be shipped to Buenos Aires in the near future.

A new firm for the manufacture of aluminum castings, **Lodi Foundry Co.,** has been incorporated at Lodi, Ohio, by Carlton Brewster and Earl Martinson, both of Orville, Ohio.

Operations previously conducted at the Des Plaines **"Plant B"** of **Chicago Foundry Co.,** are now under control of a new organization, **Wells Mfg. Co.,** with offices at 1856 Miner Street, Des Plaines, Ill. The new company is building a modern foundry on a nine-acre tract in Skokie, Ill., and expects production to begin at that site by January 1, 1947. **"Plant A"** of the Chicago Foundry Co., Chicago, continues operations as in the past several years.

Operations of **Davis Foundry Co.,** Newcastle, Ind., continue under the same firm title, following sale of controlling interest in the gray iron plant. G. L. Shank, who now owns the principal interest, becomes president and general manager; William Davis, vice-president and general manager for 29 years, retires from the firm, and Richard Netz continues as office manager.

Beardsley & Piper Co., Chicago, has purchased the **Flask Lifting Machine Div., Champion Foundry & Machine Co.,** of the same city. The Beardsley firm acquires patterns, drawings and patent rights, as well as the right to continued use of the "Champion" name.

Superior Foundry Co., Cleveland 5, has been sold, and a new company, **Superior Foundry, Inc.,** formed. W. L. Seelbach becomes president and general manager; C. F. Seelbach, vice-president, and Philip Frankel, secretary and treasurer, of the new firm. The three, together with Ralph Laubscher and Kurt Seelbach, comprise the board. G. J. Feiss, former president, will remain as consultant; and production of gray, alloy, and electric furnace iron castings will be continued.

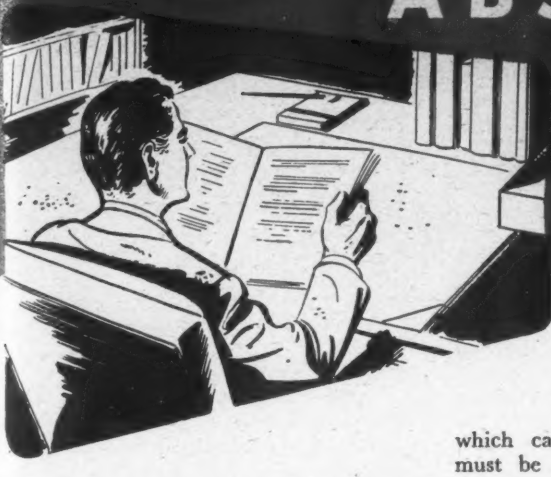
New plant for the construction of railroad journal bearings is under construction at Niles, Ohio, for **American Brake Shoe Co.,** New York. The "L" shaped structure will have an over-all length of 300 feet and an over-all width of 180 feet, and will house on the first floor a foundry and a machine shop; on the second, the office and employees' facilities. Total plant area will be 35,000 square feet.

Nearly 1,500 sub-contractors supplied materials and specialized services in the billion-dollar war construction program undertaken for the government by **E. I. du Pont de Nemours & Co.,** Wilmington, Del., M. F. Wood, assistant chief engineer of that firm, disclosed in a recent statement. Of the huge sum expended, he stated, 56 per cent went into material costs in building 54 plants at 32 locations, and the remaining 44 per cent was paid out in wages and salaries to more than 400,000 workers.

The former **Industrial Oven Engineering Co.** announces simultaneously a change in firm name to, **Industrial Ovens, Inc.,** and establishment of a new plant and offices at 13825 Triskett Road, Cleveland

11. Established in 1940 as an organization of five people, the company now numbers 42 employees in its engineering department alone.

ABSTRACTS



NOTE: The following references to articles dealing with the many phases of the foundry industry, have been prepared by the staff of *American Foundryman* from current technical and trade publications.

When copies of the complete articles are desired, photostat copies may be obtained from the Engineering Societies Library, 29 W. 39th St., New York, N. Y.

Aluminum-Base Alloys

CHEMICAL ANALYSIS. Phillips, D. F., *"Routine Analysis of Aluminum Alloys by Colorimetric Methods,"* ALUMINUM AND MAGNESIUM, August, 1946, vol. 2, no. 11, pp. 14-17.

New colorimetric methods developed during the war to speed up analyses.

COMPOSITION. Quadt, R. A., *"Aluminum Alloy,"* AMERICAN FOUNDRYMAN, July, 1946, vol. 10, no. 1, pp. 21-34.

An investigation of the effect of certain elements on the mechanical properties of an aluminum sand casting alloy with a composition of one per cent copper, 5 per cent silicon, and 0.5 per cent magnesium.

SCRAP. La Cerra, J. M., *"Handling Scrap in Small Aluminum Foundries,"* ALUMINUM AND MAGNESIUM, August, 1946, vol. 2, no. 11, pp. 18-19.

The author explains why it is best to melt scrap in a separate furnace and pour it into ingots, and describes the melting procedure.

SELECTION AND PREPARATION. Carrington, E., *"Aluminum Foundry Alloys,"* METAL INDUSTRY, July 19, 1946, vol. 69, no. 3, pp. 45-47; July 26, 1946, vol. 69, no. 4, pp. 69-72.

A consideration of alloys available, possible commercial requirements, methods of classification, the foundryman's point of view, and preparation of the type of alloy selected.

Binders

ETHYL SILICATE, Nicholas, Pierre, *"Ethyl Silicate in the Foundry,"* FOUNDRY TRADE JOURNAL, August 15, 1946, vol. 79, no. 1565, pp. 401-402.

An abridged translation of an article published in the July "Fonderie."

The article reviews the use of ethyl silicate in precision casting and suggests future uses for ethyl silicate.

Brass and Bronze

FACINGS. Pell-Walpole, W. T., *"Mould Dressings,"* METAL INDUSTRY, August 16, 1946, vol. 69, no. 7, pp. 129-134.

Bronze ingots require a mold dressing which can be used thinly but which must be strong. This article describes the experimental work on the development of such a dressing.

Clays

WEIGHTS. Ries, H., *"Weight of Clay Binders,"* AMERICAN FOUNDRYMAN, July, 1946, vol. 10, no. 1, p. 73.

A study of the comparative weights of fire clay and bentonite, and conditions which influence the weights.

Cores

GAS CONTENT. Report of the Sub-Committee T. S. 13 of the Technical Council, *"Determination of 'Gas Content' of Sand Cores,"* FOUNDRY TRADE JOURNAL, July 11, 1946, vol. 79, no. 1560, pp. 273-275.

A description of a test to measure quantitatively the gas-forming character of any sand core of sand mixture used in the foundry.

Cupolas

BALANCED BLAST. Taft, T. H. and Hallett, H. A., *"Experiences with Balanced Air Feed in the Cupola,"* FOUNDRY TRADE JOURNAL, July 11, 1946, vol. 79, no. 1560, pp. 263-270; July 25, 1946, vol. 79, no. 1562, pp. 321-324.

Uniform tuyere feed is important because it prevents the combustion zone from assuming an eccentric position. Such a condition results in one-sided lining-erosion and irregular cross-sectional distribution of heat. Attention to the air feed can improve melting conditions.

HOT-BLAST CUPOLA. Longden, E., *"Hot-Blast Cupola Design,"* FOUNDRY TRADE JOURNAL, August 15, 1946, vol. 79, no. 1565, pp. 387-395; August 22, 1946, vol. 79, no. 1566, pp. 421-430.

A study of hot-blast cupola systems including the Cameron warm-air cupola; Scheurrman hot-blast cupola; Zoller hot-blast cupola; anonymous German hot-blast cupola; Moore hot-blast cupola; Griffin hot-blast cupola; Dyer hot-blast cupola; and the Whiting hot-blast cupola.

Fluidity

TESTING. Clark, K. L., *"Fluidity Testing of Foundry Alloys,"* AMERICAN FOUNDRYMAN, July, 1946, vol. 10, no. 1, pp. 35-46.

An evaluation of published information on fluidity testing and recommendations for design details and operation.

Gray Cast Iron

CONTROL TESTS. Report and recommendations of Sub-Committee T.S. 6 of the Technical Council, *"Control Tests for Grey Cast Iron,"* FOUNDRY TRADE JOURNAL, July 18, 1946, vol. 79, no. 1561, pp. 287-297; July 25, 1946, vol. 79, no. 1562, pp. 311-316; August 1, 1946, vol. 79, no. 1563, pp. 337-345.

A review of quick check control tests which may be performed on gray cast iron. The tests may be classified as: (1) visual tests or those which quickly produce some directly observable characteristic phenomena in the actual metal; (2) rapid analytical methods; and (3) mechanical tests which in many cases merely anticipate those subsequently required by inspecting authorities.

HARDNESS. MacKenzie, James T., *"Brinell Hardness of Gray Cast Iron—Its Relation to Other Properties,"* THE FOUNDRY, October, 1946, vol. 74, no. 10, pp. 88-93.

A report on the relationship between hardness of gray cast iron and various other properties.

STRESS RELIEF. Russell, P. A., *"Heat Treatment of Grey Cast Iron for Relief of Internal Stresses,"* FOUNDRY TRADE JOURNAL, September 5, 1946, vol. 79, no. 1568, pp. 3-9.

A description of a series of experiments devised to ascertain the amount of relief of internal stress by heat-treatment in the range of 400 to 600 deg. C. and the effect on physical properties.

Magnesium-Base Alloys

DEVELOPMENTS. Carapella, Louis A., *"New Developments in Magnesium Foundry Technology,"* ALUMINUM AND MAGNESIUM, August, 1946, vol. 2, no. 11, pp. 10-13, 19; September, 1946, vol. 2, no. 12, pp. 18-20, 23.

Recent developments and proper uses of fluxes, improved melting equipment and techniques, new handling and casting methods, and probable subsequent trends throughout the industry.

HEAT TREATMENT. Eastwood, L. W. and Davis, James A., *"The Effect of*

Composition of Magnesium Alloys on Their Amenability to Heat Treatment," LIGHT METAL AGE, July, 1946, vol. 5, no. 7, pp. 8-11, 16.

This article describes how the temperature and duration of heat treatment should be adjusted to the composition of the magnesium alloy in question in order to obtain best results and, in some cases, prevent actual damage.

MICROPOROSITY. Dobkin, Herbert, *"Microporosity in Magnesium Alloy Castings,"* THE FOUNDRY, October, 1946, vol. 74, no. 10, pp. 98-101, 178, 180, 182.

Theories of microporosity, means by which it can be minimized, and its effects on mechanical properties.

Malleable Cast Iron

MALLEABLIZING. Dovey, D. M., *"Notes on the Process of Gaseous Malleablising with Especial Reference to the Use of Steam,"* FOUNDRY TRADE JOURNAL, August 1, 1946, vol. 79, no. 1563, pp. 347-351.

Consideration leading to the selection of an annealing process and of the points of practical importance associated with it.

Materials Handling

TRUCKS. Turner, R. S., *"Elevating Trucks in the Foundry,"* FOUNDRY TRADE JOURNAL, June 27, 1946, vol. 79, no. 1558, pp. 225-227.

A description of the manner in which a foundry solved its problems in transporting sand castings, scrap metal, molds, patterns, flasks, and rubbish by the use of various types of stillages.

Operating Economy

WASTE. Edgar, A. J., *"Correction of Foundry Waste,"* THE FOUNDRY, October, 1946, vol. 74, no. 10, pp. 94-95, 168, 174, 176.

A discussion of ways in which waste is likely to occur and how it may be eliminated from cupola operation, coremaking, molding, shaking out, cleaning, grinding, and shipment.

Patterns

RECORDS. Cech, Frank C., *"Pattern Records,"* THE FOUNDRY, October, 1946, vol. 74, no. 10, pp. 86, 202, 204, 206, 208.

Requisites for an adequate system of pattern records.

Precision Casting

METHODS. *"Precision Casting Process,"* AMERICAN FOUNDRYMAN, July, 1946, vol. 10, no. 1, pp. 73-82.

A description of the precision casting process as carried out at the Haynes Stellite Co.

Refractories

CUPOLA. Lally, E. J., *"Cupola Refractories,"* AMERICAN FOUNDRYMAN, July, 1946, vol. 10, no. 1, pp. 47-48.

Selection of methods and materials for lining and patching cupolas.

Safety and Hygiene

ILLUMINATION. Kahler, William H., *"Planned Lighting for the Modern Foundry,"* THE FOUNDRY, October, 1946, vol. 74, no. 10, pp. 82-85, 226, 228.

Requirements of a lighting system, quantity and quality of light, light sources, selecting luminaires, layout for lighting, and maintenance.

Sand

SYNTHETIC. Marais, J. J., *"Synthetic Sand Practice,"* FOUNDRY TRADE JOURNAL, August 22, 1946, vol. 79, no. 1566, pp. 413-419.

A discussion of special problems of the South African foundry industry.

Steel

INSPECTION. Honeyman, A. J. K., and Fisher, A., *"Defects in Steel,"* IRON AND STEEL, March, 1946, vol. 19, no. 3, pp. 103-109.

An account of many of the more frequent defects encountered in steel and of their detection.

MILL ROLLS. *(See Gray Cast Iron.)*

LOW TEMPERATURE PROPERTIES. Sims, C. E., and Boulger, F. W., *"Cast Steels—Low Temperature Properties,"* AMERICAN FOUNDRYMAN, July, 1946, vol. 10, no. 1, pp. 49-66.

Twenty-eight cast steels were tested to determine their notched-bar behavior at temperature between 80 and -100 deg. F. The data indicated that the notched-bar properties characteristic of a heat of steel were not reflected consistently by any other property measure.

Stress Analysis

X-RAY. McCutcheon, Don M., *"Industrial Applications of X-Ray Stress Analysis,"* INDUSTRIAL RADIOGRAPHY, Spring Number, 1946, vol. 4, no. 4, pp. 9-16.

Qualitative stress analysis by x-ray diffraction; quantitative x-ray stress analysis; electrical recording of effects.

Supersonics

APPLICATIONS. *"Supersonics in Metallurgy,"* METAL INDUSTRY, August 16, 1946, vol. 69, no. 7, pp. 136-138.

Applications of supersonics in lowering the solidification temperature of metals, tinning of aluminum, modification of magnetic properties, and increasing the chemical activity of metals.

Testing

HIGH TEMPERATURE. Blackman, T. M., Nourse, P. R., and Plesset, E. H., *"Tension Testing at Elevated Temperatures,"* ASTM BULLETIN, May, 1946, no. 140, pp. 32-37.

A description of a simple and inexpensive method of heating tension specimens by resistance heating, a method of measuring specimen temperatures, and two types of extensometers and the associated electronic equipment for use with a Baldwin-Southwork recorder.

A technique for determining the true load at fracture of ductile specimens is also described.

NON-DESTRUCTIVE. Juppenlatz, John W., *"Other Non-Destructive Methods of Testing,"* AMERICAN FOUNDRYMAN, January, 1946, vol. 9, no. 1, pp. 38-41.

The value of non-destructive testing method depends upon the standards used to interpret defects. Standards should be based on service conditions of the material tested and should clearly differentiate between acceptable and non-acceptable classifications.

Time and Motion Studies

DEVELOPMENT. Reitinger, Harry, *"50 Years of Progress in Foundry Time and Methods Study,"* AMERICAN FOUNDRYMAN, July, 1946, vol. 10, no. 1, pp. 67-72.

Application of proper wage incentives, to the end that increased production in the foundry will advance the industry.

Can You Help?

A.F.A. is anxious to obtain some copies of A.F.A. TRANSACTIONS, Volume 52 (1944) from members who may have no use for copies in their files. The supply of this volume is entirely exhausted and a number of important requests have been received for this edition.

For intact copies in good condition A.F.A. will be glad to make arrangements for purchase. If you have a copy of Volume 52 which you do not need, please forward promptly to: The Secretary, American Foundrymen's Ass'n, 222 West Adams Street, Chicago 6, Ill.

Beg Your Pardon

AMERICAN FOUNDRYMAN regrets erroneous inclusion, traceable to a duplicate application, of Erie Malleable Iron Co., Erie, Pa., in the "New A.F.A. Members" list for the September issue. The firm has held company membership since 1945; and P. H. Vincent, general manager, whose name was shown, held personal membership from 1937 until conversion to company membership.

Personalities

(Continued from Page 88)

B. M. Loewenstein assumed the position of general sales manager, Howard Foundry Co., Chicago, in a recent appointment.

W. H. Bailey has advanced to the position of manager, coke and by-products sales, Alabama By-Products Corp. and its subsidiary A B C Coal & Coke Co., both of Birmingham. A member of Birmingham District A.F.A. chapter, Mr. Bailey has been with the Alabama By-Products firm since graduation from Birmingham Southern College, of that city, in 1926, the past several years as assistant manager, coke and by-products sales.

A. B. Drastrup has been appointed manager, alloy steel sales department, A. M. Byers Co., Pittsburgh, Pa. Mr. Drastrup, who has been with the firm since 1931 in accounting, industrial engineering and plant management capacities, was previously associated with Columbia Steel Co., Torrence, Calif., and Gary Works, U. S. Steel Corp., Gary, Ind.

H. A. Trishman, for 20 years chief engineer, Adamson United Co., Akron, Ohio, ends that association in joining Erie Foundry Co., Erie, Pa., as manager, Hydraulic Division.

J. M. Diebold, until recently head of the welding department, Truck & Coach Div., General Motors Corp., Pontiac, Mich., now heads the production engineering department, Rudolph Wurlitzer Co., North Tonawanda, N. Y. Mr. Diebold will be recalled by readers of AMERICAN FOUNDRYMAN as one of the authors of *Cast Iron Repair Welding, Metallurgical Aspects,* in the September issue.

R. J. Leckrone, until recently chief engineer, Lewis Foundry & Machine Div., Blaw - Knox Co., Pittsburgh, heads engineering activities for both Glassport and McKees-

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Personalities

(Continued from Page 98)

port, Pa., plants of Pittsburgh Steel Foundry Co., following appointment as chief engineer in charge of engineering and machinery sales for the latter firm. His headquarters will be at Pittsburgh.

C. W. Baker, a member of the engineering staff, Lewis Foundry & Machine Div., Blaw-Knox Co., Pittsburgh, since 1929, assumes the position of assistant chief engineer in a recent promotion, and takes on additional duties specializing in design of products.

A. K. Lucas serves as plant manager, Lancaster Foundry Corp., Lancaster, Ohio, following a recent promotion.

P. F. Bronckhurst, whose background is in consulting engineering work on machine tools and hydraulic equipment, takes charge of the new Denver office of Hydropress, Inc., New York.

J. W. O'Brien, associated for 13 years with United Engineering & Foundry Co., Pittsburgh, and formerly assistant chief engineer, advances to chief engineer; and is succeeded as assistant by **H. N. Fry,** who has been with the firm for 24 years, in new company appointments.

J. E. Fifield, formerly assistant to the plant manager and foundry metallurgist, Naval Research Laboratory, Washington, D. C., now makes his headquarters at Hartford, Conn., having joined the development and research division, International Nickel Co., as a member of the New England technical section, of which **D. A. Nemser** is manager.

J. E. Anderson heads the new Indianapolis sales and service office of Whelco Instruments Co., Chicago; is assisted by **W. A. Jones,**

J. E. Anderson

service engineer; and has direction of a sub-office in Cincinnati, where **L. A. Wallingford** serves as district manager.

F. P. Smith, since his return from active duty with the U. S. Navy, a representative in the Philadelphia area for E. I. du Pont de Nemours & Co., Wilmington, Del., is now a sales engineer for the firm in the Cleveland region.

John Imhoff, production manager of vacuum tube manufacture, General Electric X-Ray Corp., Chicago, has been elected president, Chicago chapter, Society for the Advancement of Management.

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Personalities

(Continued from Page 102)

P. R. Eisenhuth and **W. F. Helies,** formerly associated with Velsicol Corp., Chicago, have organized Cyclic Chemical Corp., with offices at 75 E. Wacker Drive, Chicago, and others to be established in New York and Washington, D. C.

J. A. McConnell, military government and personnel officer with the U. S. Navy during 1944 and 1945 and previously a member of the personnel staff, General Motors Corp., Detroit, is now associated as sales representative in Columbus, Ohio, with Automatic Transportation Co., Chicago.

N. L. Mooneyham was recently appointed western district sales manager for the complete line of products of Velsicol Corp., Chicago, and continues in charge of nation-wide core oil sales. Mr. Mooneyham, who joined the Velsicol firm in 1935, is an A.F.A. member, active in the Chicago chapter for many years.

G. C. Tolton has been named sales representative, Northwestern states, with headquarters in Seattle, Wash.; **Anthony Stimmler** has been named to similar capacity in the new Minneapolis sales office, and **M. R. Christensen** in the new Denver territory, by American Foundry Equipment Co., Mishawaka, Ind.

H. F. McGinn, vice-president, Eaton Mfg. Co. and general manager Eaton Reliance Division, Massillon, Ohio, has announced the appointment of **R. F. Golden** as head of the company's new research and development department, at Massillon.

Clarence Finkler has moved from Westinghouse Electric Corp., Chicago, to Chicago Brass Works, of the same city.

E. W. Smith, formerly works manager Lindahl Div., American Gear & Mfg. Co., handles foundry sands, agrigates, bentonites, clays and silica flour in the Chicago and northern Indiana areas, in a new association, with Western Materials Co., Chicago.

J. H. Mighton, following recent release from the Navy, joins the magnesium sales staff, Dow Chemical Co., Midland, Mich., and will be concerned with sand and permanent mold castings orders.

R. W. Mason, Jr., has joined the development and research division, International Nickel Co., Detroit, as metallurgist and consultant on the use of nickel in castings. Mr. Mason was formerly associated with Lithium Co., Newark, N. J.

Dr. F. H. Clark, formerly metallurgist, Western Union Co., New York, is now on the staff of A. R. D. Corp., New York.

C. B. Colwell, who handled sales of alloy and stainless steels for Carnegie-Illinois Steel Corp., Chicago, joins Jessop Steel Co., Washington,

Pa., as special sales representative with headquarters in the firm's Chicago office. He will specialize in the sale of solid stainless steels, stainless-clad steels, and stainless steel, heat-resisting and acid-resisting castings.

Obituaries

Professor Frederick R. Evans, Massachusetts Institute of Technology, Cambridge, died September 15 at his home in Lexington, Mass., after a brief illness.

Professor Evans had been at MIT since 1938, and during the war was engaged in important war work there. A native of Larchmont, N. Y., he received his degree in mechanical engineering at Cornell University, Ithaca, N. Y., in 1938 and his degree of master of science at MIT in 1941.

He held membership in the American Foundrymen's Association, the American Society for Metals and the Society of the Promotion of Engineering Education. With the A.F.A., Professor Evans was active in a number of national groups, including the Committee on Cooperation with Engineering Schools, the Subcommittee on College Foundry Courses of that group, and the committees of Flowability and Deformation, Foundry Sand Research Project.

Murray Kice, Jr., chief engineer, American Blower Corp., Detroit, died September 25 after a two-year illness.

Mr. Kice, a native of Louisville, Ky., began a life-long association with the American Blower firm immediately after his graduation from Purdue University, Lafayette, Ind., in 1915. Starting as a mechanic in the fan shop, he advanced rapidly to sales engineer, and was successively in charge of Columbus, Cincinnati and Indianapolis territories before appointment to the position of chief engineer in 1937.

Prominent in the heating and ventilating industry, and author of many published articles, he was active in the American Welding Society, Engineering Society of Detroit, American Society of Heating and Ventilating Engineers and American Society of Mechanical Engineers.

New Literature

(Continued from Page 89)

comprehensive list of Kodak formulas and discussion of principles and procedures for processing films, plates and papers; new section concerning identification and source of negative faults has been added; and the booklet, designed and punched to replace earlier sections of the Kodak Reference Handbook, inaugurates a new system of designating Handbook revisions.

"Two-Stage Centrifugal Pumps" are the subject of a two-color, 16-page catalog, Form 7062, published by Ingersoll-Rand Co., 11 Broadway, New York 4. Cutaway views, types of drives and typical installations are shown; and tables of performance, dimensions and pipe friction are included.

"Paranews for Foundrymen," issued by Foundry Rubber, Inc., 1050 30th St. N. W., Washington 7, D. C., contains a check sheet of uses for seven company products, together with brief descriptions of each, and a listing of firms which use them. Also available from Foundry Rubber, Inc., are a number of data and instruction sheets, giving characteristics, applications and directions for use, of the materials.

Application of fluxes for production of sound castings is the subject of "The Why and How of Fluxes and When and How to Use Them," by H. O. Jarvis, managing director, Niagara Falls Smelting & Refining Corp., Buffalo, N. Y., and available from the firm on request. Booklet is a condensed version of various talks before foundry groups, brought up to date with latest developments in technology.

The history of grinding wheels and an explanation of the fundamentals of grinding wheel operation, are presented in "Grinding Wheel Information," a 94-page booklet compiled by Mid-West Abrasive Co., Owosso, Mich. Well illustrated with photographs and line drawings, it also contains specification

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EXECUTIVES:

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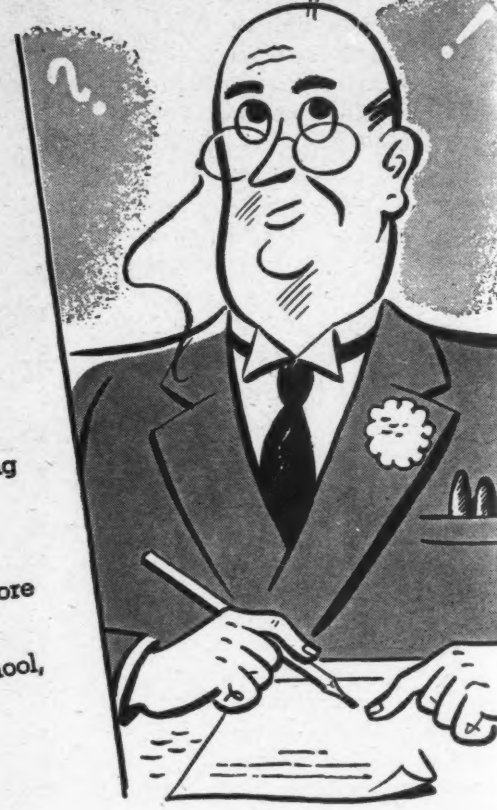

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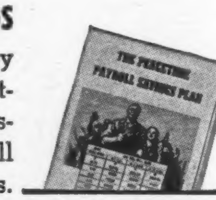
THE PEACETIME PAYROLL SAVINGS PLAN—A booklet, published for key executives by the Treasury Department, containing helpful suggestions on the conduct of your payroll savings plan for U.S. Savings Bonds.



THIS TIME IT'S FOR *YOU*—A booklet for employees . . . explaining graphically how the payroll savings plan works . . . goals to save for, and how to reach them with Savings Bonds.

The Treasury Department acknowledges with appreciation the publication of this message by

AMERICAN FOUNDRYMAN

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and The Advertising Council

New Literature

(Continued from Page 107)

data on all types of wheels. The firm also offers a 32-page catalog, "Mid-West Dependable Abrasives," designed for the purchasing executive and engineer, and containing data and illustrations on coated abrasives, wheels, honing and sharpening stones and abrasive specialties.

Chemical cleaners and drawing compounds manufactured by Northwest Chemical Co., 9310 Roselawn, Detroit 4, are described in a conveniently wire-bound collection of bulletins issued by the firm. Described are electrolytic, immersion, solvent and spray cleaners, water-wash compounds and drawing compounds.

Eye protection is the purpose of the "StaSafe" plastic eye mask, described in a 4-page folder issued by Standard Safety Equipment Co., 232 W. Ontario St., Chicago 10. Special features are outlined.

Chemical and physical properties of ammonia and the general precautions to be observed in its safe handling and application, are fully discussed in the 1946 edition of "Ammonia in Metal Treating," 40-page illustrated booklet available from The Mathieson Alkali Works, 60 East 42nd St., New York 17. Detailed explanations of use of ammonia either as a furnace atmosphere or a source of pure hydrogen in various processes, are incorporated.

Testing locking effectiveness of self-locking nuts and related fastening devices is described in "Test Procedure," a 16-page booklet prepared by Dr. J. A. Sauer, head of the department of engineering mechanics, Pennsylvania State College, State College, Pa., and published by the Elastic Stop Nut Corp. of America, Union, N. J. Equipment and procedure for making tests on vibration, installation and removal torque, re-use torque, wear and plating, are described and shown; and evaluation of test results in connection with individual fastener problems is outlined.

Index to Advertisers